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SOME PRINCIPLES OF FOREIGN TRADE.

During the past two weeks, while the war cloud thickens abroad, economists on both sides of the water have had a good deal to say with regard to the possibilities of the manufacturer in the United States participating to a greater degree in the commerce and trade of those countries heretofore almost entirely dependent upon either England, Germany, Italy, France or Russia for their larger supplies of fabricated material.

It seems reasonable to presume that if the foreign workshops are shut down for any considerable period, and with practically all of the sea-going nations abroad in a belligerent attitude, that the exports of those countries must shrink very materially. With no selfish spirit then, it would seem to be the opportunity and the right of the manufacturers in the United States to see to it that if such a market be available that information of a most accurate nature respecting requirements and methods of doing business be secured as expeditiously as possible. In this contingency the records of the Bureau of Foreign and Domestic Commerce are available to our manufacturers, and the Chamber of Commerce of the United States of America is also in a position to help materially. While spasmodic efforts have been made by some manufacturers to develop business with the Latin-American countries, China, Japan and Asia, comparatively little is known in the aggregate either with regard to the requirements of the people there or their methods of doing business. It is a fact that in these places the American manufacturer has done a good deal to discourage dealing with this country because of an inequitable and vacillating policy with respect to his handling of orders and his desire to secure this business. When conditions in the United States have been depressed there has been a mild stampede to the other countries and orders have been booked enthusiastically. When, however, conditions have improved so that the factories are busy, it has not been the exception in the past to find the business so ardently solicited one year, scorned the next, and the contractor or builder or promoter in those countries have consequently sometimes been left in the lurch when refitting, rehabilitation or extension became necessary.

At a recent meeting of the Manufacturers' and Wholesale Merchants' Board of the Cleveland Chamber of Commerce, Mr. C. S. Donaldson, chief of the Consular Division of the Bureau of Foreign and

Domestic Commerce, delivered a valuable and suggestive address respecting "Some Principles of Foreign Trade." In the course of his remarks Mr. Donaldson revealed some startling figures with regard to the possibilities of foreign business, and this address was made at a time when no one had in mind the conditions that are now upon us. How many people know that of the one and one-half billion people in foreign countries fully one billion enjoy almost none of the comforts with which we are familiar. India has over three hundred million people and there is scarcely a modern bathroom in the entire empire. China, with a still larger population, is in a like position. The scale of living and wage recompense are still low in Asia, but these are potential markets. When Mr. Donaldson came into the service of the government as an aid to export trade nine years ago, United States consuls in India were emphatic in stating that modern agricultural implements could not be sold there. Today there is nothing probable about it—they are sold in India. Wages in Japan, though still low, have doubled in the past decade. At least 20 cents a day has been added to the average daily income of the man in Japan. That country's total foreign trade has increased from $70,000,000 in 1891 to over $500,000,000 in 1913. Her imports of foreign goods have increased from $1.40 per capita to $10 per capita. As the wage scale moves up so does the purchasing power of the nation move with it. The leaven is slowly but surely working through Asia and wonderful changes will occur there during the next decade. Add only 20 cents a day to the income of the 160,000,000 families in all Asia and we have an increased spending power of ten billion every year, and Asia's increased purchases should be greater than that a generation hence. Just about half of the people in the world today, 800,000,000 in Asia, are importing foreign goods to the value of $1,900,000,000 annually. While this sum sounds enormous it must be realized that it is less than $2.40 per capita against Australia's $70 per capita. If we could put the purchasing power on a basis of $3 worth of American goods each year it would amount to $2,500,000,000, or what we are now selling to the entire world. Our annual sales to Asia today figure in the neighborhood of $120,000,000 or only 15 cents per capita of Asiatic population.

Where United States manufacturers have made a study of conditions in Asia and in countries similarly situated, with regard to our possible trade extension, they have met with considerable success. A knowledge of the way to do business in those countries, however, is not easily secured and not at all in a single season. The Government departments are organized for team work and co-operation with the Chambers of Commerce of the progressive cities of the United States. It is a well known contention among the officers of the Bureau that the manufacturers of the United States do not utilize their organization to anything like the extent that they should. Here, then, is a possibility for trade expansion that should have attracted the intelligent attention of manufacturers even in a time of keen competition with the manufacturers abroad. Now, when because of the unfortunate unsettlement of industry abroad the opportunity of the manufacturer in this country seems forced to his attention, will it not be well to begin at once to realize upon the latent possibilities?

Out of strife and struggle has always come the period of greatest development in this country. During the awful days of the Civil War, when the ports of the South were closed to the industries of the northland, an entire readjustment of facilities and business became necessary. The commerce of the country was changed about and in a miraculously short time native genius blossomed and invention had its greatest opportunity. Chicago's supremacy as a grain center of the world, her leadership in the packing industry, are the direct results of the courageous efforts of brave commercial captains to live up to the opportunities forced upon them through the closing of the ports of the South, and the city of Saginaw and other populous places now along the river came into being because of the increased industrial opportunities due to the development of the new business centers. Dispatches from Paris contain the report that the French government has placed an order with Armour & Company for 2,000,000 pounds of canned beef for army rations. Without considering now just how these supplies are to be shipped and delivered in view of a close adherence to the neutrality laws, if such requirements as this are magnified many times can anyone conjecture the expansion that should come to this country in its hour of peace while the other nations of the world are at war with each other?

LONG-DISTANCE TELEPHONY.

The marvelous extension in the area of communication by telephonic means made possible by the application of Pupin loading coils to telephone lines is well brought out in a lecture which was given by Prof. J. A. Fleming last spring before the Royal Institution of Great Britain. An abstract of the lecture was published in our last issue, and contains a convenient tabulation of some of the longest lines which are now used in telephonic transmission in both this country and Europe.

Commercial telephonic communication between New York and Denver has been in operation for some time and there is a possibility that it may be extended to the Pacific Coast in the not distant future. Before the application of the principle of loading, such an accomplishment was not only impossible but outside of the realm of conjecture. Probably few outside of the electrical profession realize how much Professor Pupin has done in the interests of long-distance telephony.

INTENSIVE CULTURE OF NEW BUSINESS.

The new-business departments of central stations follow a great variety of methods and lack of method in the conduct of their activities. There are few, if any, large companies which today lack a new-business department, but among the small companies a separate organization for soliciting purposes is not always feasible. In the latter, as in some of the companies with employees assigned to this particular work, solicitation is rather desultory and without any definite plan.

Other companies having a definite organization for new business attack the work in a rather indiscriminate fashion and without a definite policy. In some cases an effort is made to completely cover the territory and it may even be raked with a fine-tooth comb in the effort to sign every contract which may seem at all possible. Solicitors are often sent out from the office without very definite instructions and without any definite plan of operations, and are left to flounder as best they can and secure any business of which they are capable.

Better than either of these methods is the one which involves a study of the field available to the central station and then the planning of an intensive campaign along the lines which appear to be most promising. The problem is definitely studied; it is decided what business is most desirable to attach to the lines of the central-station company, and the latter receives the first attention in the campaign of solicitation, such groups of prospects being thoroughly covered; the cost of getting the business is considered, as well as its desirability after being secured. In the directions in which this cost is excessive, little effort is expended. Lines of possibilities in which the business can never be considerable, or which in its nature constitutes a less desirable load, are not so actively solicited, but may receive attention at times when other work cannot well be prosecuted. In carrying out this method the head of the department first formulates his plan and then sees to it that his men are thoroughly familiarized with his ideas, so that they are in a position to carry out his plan of campaign. Where necessary the men are trained to apply their efforts in the most productive way, and the entire force has a definite goal at which to aim. Unless the solicitors know what is desired by their superior officer they cannot, of course, work in harmony with his plan, and yet many solicitors start out without knowing just what their superiors consider the most desirable line of work for them.

It must be realized that in certain geographical sections and under certain conditions there are power applications which the central station cannot hope to serve if considerations of cost are paramount. It must be found out in such cases whether other advantages of electric drive are of more importance than the cost feature. Where there seems little likelihood of securing such business without a disproportionate effort, it is a mistake to solicit along these lines until the more promising avenues of expansion have been thoroughly covered.

CORPORATION POLICY AND PUBLIC SENTIMENT.

In order to thoroughly understand any controversial subject it is necessary to familiarize oneself with both sides of the question. A good debater always does this in order to be prepared to answer the arguments of his opponent. The desirability of municipal ownership and operation of public utilities is at present in dispute in many sections of the country and the advocate of private management should prepare himself to thoroughly understand the attitude of the protagonist of public ownership.

In the majority of cases the municipal operation of utilities has not been efficient, although in exceptional cases where there have been loyal and capable managers good results have been obtained. The accounting of municipal plants is, however, usually in too hazy a condition to show clearly their financial status. Where the facts have been sifted, however, they usually show no financial advantage to consumers or taxpayers from this activity of government. Even where this is known, however, it frequently does not convince the voters that municipal operation is not desirable, and it is very evident that the cost of service is not the only consideration which actuates them. They often seem willing to make some financial sacrifice for the sake of eliminating a utility corporation.

This attitude of the public seems to be due to a conviction in some quarters that large corporations, especially those of the public-service type, have had a baneful influence in the life of many communities. Such a sentiment does not usually discriminate between "good" and "bad" corporations, but places them all in the same class. All corporations are at present suffering from the odium which has arisen from the past performances of certain industrial, railroad and other utility corporations. It is hard for some managers of utilities which have had no part in creating this sentiment to understand why it should exist. A perusal of such a book as "The Beast," by Lindsey and O'Higgins, will, however, make this attitude more comprehensible, and this book should be read by every utility man who wishes to understand the anti-corporation sentiment which is so much in evidence.

The corporation policies of the past which have been responsible are now happily being discarded and the modern policy and attitude of utility corporations is entirely different. There is less inclination to participate in politics, although in some communities where corporations are subject to blackmail by unscrupulous politicians it is not possible to keep out. In most communities, however, the attitude of straightforward dealing with the public has been adopted, and where a franchise is to be renewed methods which were adopted in 1906 would not be thought of today. In the fight for a franchise in Toledo, Henry L. Doherty is showing the world a fine example in meeting criticism face to face and gaining the popular suffrage through sheer might of logic and appeal to reasoning power.

Society for Electrical Development Announces Committee of Award.

The Society for Electrical Development, Incorporated, New York City, announces the following Committee of Award on its prize story competion, which closes September first:

Edmund L. Pearson, editor of publications, New York Public Library, author of "In Believing Years," "The Voyage of the Hopper-Grass," "The Secret Book," etc.

F. J. Urquhart, assistant editor, *Newark Sunday Call,* author of "A School History of Newark," "A Larger History of Newark," etc.

J. M. Wakeman, general manager, Society for Electrical Development, formerly vice-president and general manager, McGraw Publishing Company.

The competition, which is open to employees of members of the society only, is creating widespread interest, and some interesting contributions to current electrical literature may be expected.

As stated in our issue for June 20, 1914, prizes of from $10.00 to $250.00 will be awarded for the best stories, articles or reports or any subject pertaining to commercial electricity. The authors' names will be unknown even to the judges until after the final awards are made.

Full information will be furnished on application to Competition Editor, The Society for Electrical Development, 29 West Thirty-ninth Street, New York City.

Coon Rapids Hydroelectric Development in Commercial Operation.

The first 2,100-horsepower unit of the Coon Rapids hydroelectric development was placed in commercial operation on August 1 and has since been turning current into the lines of the Minneapolis General Electric Company. This unit is the first of five, all of which it is anticipated will be completed and placed in service by November 1, 1914.

Construction of this plant was started in February, 1913, under the supervision of the engineering department of H. H. Byllesby & Company, and the dam proper was completed January 7, 1914, in accordance with the terms of the Federal permit granted the company.

Although the development was financed on a lowering security market and at a time when money for new enterprises was being held back, it was accomplished with little difficulty showing the strong position of the Minneapolis General Electric Company, which company has leased the development and for whose purposes it was built. One of the features of the financing was the offering and sale of a large block of the bonds locally in Minneapolis.

Home Exposition to be Held in Chicago.

A Home Exposition will be held in the Coliseum, Chicago, Ill., from September 16 to 26 inclusive. This exposition will include everything that increases the comfort, convenience, economy, beauty and sanitary conditions of the home and will also include a pure food show.

This exposition is being promoted by an organization of experienced and successful business men under the name of the Home Exposition Company. C. A. Channell, president of the Channell Chemical Company, is president of the exposition company.

Already a number of electrical manufacturers such as the Bissell Motor Company, Capital Electric Company, Chicago Electric Motor Company, Conlon Electric Washer Company, Eden Electric Washer Company, Federal Electric Company and Franz Premier Electric Company, have secured booths in which to demonstrate the comfort, convenience and economy of electrical devices for the home.

Further particulars may be obtained by writing to Thomas P. Convey, secretary of the Home Exposition Company, 162 North Dearborn Street, Chicago, Ill.

Opening of the Panama Canal to Traffic.

The Secretary of War has announced that the Panama Canal will be opened to traffic on Saturday, August 15, to vessels drawing not to exceed 30 feet of water. This stipulation is made, because of the conditions at Cucaracha slide, in the Culebra cut section which, although greatly improved, would not admit of the passage of vessels with absolute safety drawing a greater depth of water. This restriction, however, probably does not affect any vessel now using the Panama route regularly, either in the Atlantic or Pacific.

Plans Being Formed For Inspection Bureau in Duluth.

A movement has been launched in the City of Duluth, Minn., for the establishment of an electrical inspection bureau. A meeting was held in that city last week at which were present Mayor Prince and Commissioner Hicken, and representatives of practically the entire electrical industry of the city, W. N. Ryerson, manager of the Great Northern Power Company, acting as temporary chairman. Mr. Muldaur, of the Society for Electrical Development, who was present at the request of the local electrical interests, submitted to the meeting data on electrical inspection in various cities, and other information which the Society has collected. After a careful discussion of the matter, a committee was appointed, consisting of C. E. Van Bergen, secretary and manager of the Duluth Edison Electric Company; A. W. Lindgren, manager of the Northern Electric Company, and F. E. Hough, city inspector. This committee is empowered to draw a tentative ordinance, which will be submitted to the mayor and commissioners, and when approved will be adopted by the city. The city government is working in close harmony with the electrical interests of Duluth, and it is believed that a speedy solution of the matter will be reached.

Electric-Railway Foreclosure Postponed.

The receivers' sale of the property of the Warren, Brookfield & Spencer Street Railway Company, set for August 6, was postponed to September 10, owing to the lack of bidders, when the property will be offered, for the fourth time, at the Brookfield, Mass., office of the company. The International Trust Company of Boston holds a mortgage on the line to satisfy which the property is to be foreclosed. The line is 20 miles in length extending from Spencer to West Warren, with a branch from East Brookfield to North Brookfield. Power station, car barns and office are located at Brookfield. The terms of the decree provided that no bid of less than $150,000 could be received.

National Electric Vehicle Day Indorsed.

Indorsements of the suggestion of Robert Montgomery, manager of the commercial department of the Louisville Gas & Electric Company, that a national Electric Vehicle Day be established, have been received by Mr. Montgomery from many sources since his suggestion was published in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN not long ago. The idea is hailed as altogether practical and co-operation in working it out is promised. The electric vehicle, it is noted, is ideal for parades, since it does not suffer under the probability of the frequent stops and starts and slow speeds, as is the case with the gasoline cars.

Copper Exports.

Exports of copper for the week ending August 6 totaled 5,056 tons; since August 1, 4,212 tons.

Electrical Standardization in China.

There are at present no recognized standards of electrical supply in China. In some instances direct current is supplied; in others, alternating. There are different phases, frequencies, and voltages. The Engineering Society of China, however, is working with a view to the standardization of the supply, to be followed by some practical and effective plan for the standardization of the materials used in this line. A committee appointed to consider the subject has arrived at the following recommendations and decisions, which have been circulated as widely as possible in Europe and America in order to obtain free and valuable discussions and suggestions:

1. That generation and distribution generally shall be on the three-phase system at 50 or 60 cycles per second.

2. That distribution shall be carried out generally on the four-wire and three-phase system with grounded neutral at a pressure of 250 volts between each phase and neutral, i. e., 440 volts (approximately) between phases.

3. That the standard pressure for domestic lighting and similar supply shall be 250 volts.

4. That when it is not desirable or economical to use a four-wire three-phase supply, then a three-wire system with neutral grounded or a two-wire system with one side grounded shall be adopted; in all cases the pressure to ground shall be 250 volts.

5. That the use of direct-current systems shall be discouraged and they shall not be allowed for systems involving either over 50 kilowatts in capacity or having feeders of over one-half mile in length.

6. That no fuses or switches shall be allowed in the neutral wire.

7. That where direct-current systems are essential the generation and distribution shall be on the three-wire system at 500 volts between outers, the neutral being grounded.

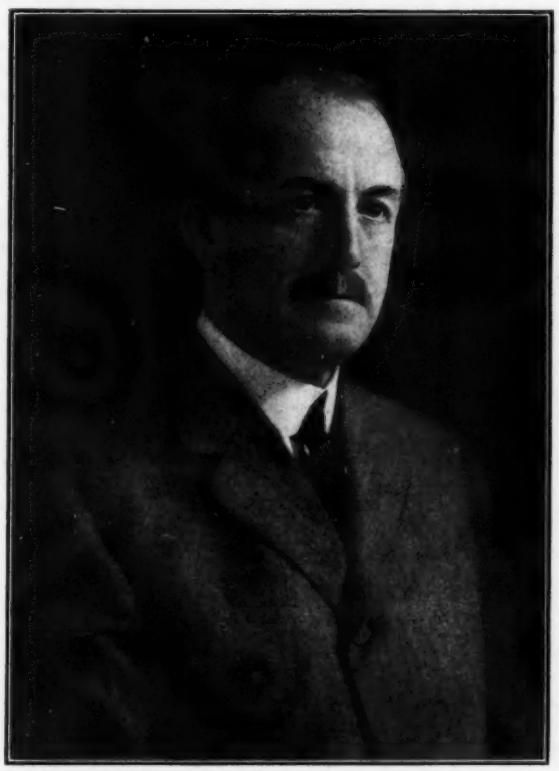
8. That the following pressures shall be considered as standards for high-tension transmission: 2,200 volts, 3,300 volts, 6,600 volts. Pressures above 6,600 volts are to be as required by local and other conditions.

An automatic telephone exchange will be installed at Christiania, the capital of Norway.

Theodore W. Siemon.

Theodore W. Siemon, who has been known for years in New York and Pittsburgh financial circles, has been elected secretary and treasurer and a member of the board of directors of the Union Switch & Signal Company, succeeding James H. Johnston, retired.

Mr. Siemon was born on the North Side, Pittsburgh, Pa., where he also received his early school education, attending afterwards Iron City College, Pittsburgh. He began his business career in 1877 as an office boy with Lewis, Oliver & Phillips, now the Oliver Iron & Steel Company. He remained with that firm until 1887, when he accepted a position with the Philadelphia Natural Gas Company as assistant to J. R. McGinley, who was secretary and also had charge of the distribution and selling of the company's product. In 1893 he was placed in charge of the business of the Allegheny Heating Company, a subsidiary of the Philadelphia Company, as assistant treasurer under Mr. McGinley. He held that position for two years when he was transferred to the general offices of the company in Pittsburgh as treasurer. From that position he was promoted to the office of general manager.



Theodore W. Siemon,
Secretary and Treasurer, Union Switch & Signal Company.

In 1899, when Mr. Westinghouse disposed of his interests in the Philadelphia Company, Mr. Siemon also severed his connection, and he was then elected assistant treasurer of the Westinghouse Electric & Manufacturing Company, with headquarters in New York City. He succeeded to the treasurership in 1906 after the death of P. Ferd Kobbe. In 1907 the office of the treasurer was transferred to East Pittsburgh, and Mr. Siemon has been there ever since. During 1907 and 1908 he was also a director of the Electric Company. He has been a director in the Bryant Electric Company and the Perkins Electric Company since 1906.

Mr. Siemon entered upon his connection with the Union Switch & Signal Company on August 1.

Wireless in Polar Exploration.

The success of Dr. Mawson's wireless telegraph equipment, by means of which his base on the Antarctic Continent was kept in touch with the rest of the world through his other station at Macquarie Island, directed a good deal of attention to the possibilities of wireless communication for polar exploration work, and it is to be hoped that the desired funds will be forthcoming so that Sir Ernest Shackleton's Antarctic expedition can be provided with all they want in this direction, says *Electrical Engineering*, London. There is also much experimental work of interest that could be done if his party were able to establish fairly powerful stations at the two proposed bases, one on each side of the Continent.

First of all, there is some question as to whether communication could be maintained at all between them, owing to the height of the mountain ranges intervening and the probable high degree of ionization of the air in polar regions, apart from the difficulties of maintaining high aerials in the violent winds that are experienced. There are many problems regarding the effect on wireless transmission of the extreme climatic and meteorological conditions that might be studied. It is to be hoped, too, that it will be found possible to devise a satisfactory sledging set within a practicable weight limit, but a good deal of experimenting will probably be required as to a suitable form of aerial and earth connection or its equivalent.

Hydroelectric Development and Irrigation.

An interesting paper entitled "Hydroelectric Development on Public Lands in Relation to Irrigation" was presented by E. C. Finney, attorney for the United States Reclamation Service, before a recent conference of reclamation service attorneys in Salt Lake City. The following paragraphs dealing with electrical development in the West are taken from this paper:

Water-power development and irrigation of arid lands in practically all of our western states are inseparable, or at least closely related. Congress recognized the importance of utilizing the electrical energy developed in connection with gravity projects for the pumping of water to high levels.

The reclamation law of June 17, 1902, said nothing about the development of hydroelectric power, but four years later Congress recognized the fact that power should be developed and might be necessary for the irrigation of lands under such projects, and provided that in such cases surplus power or power privileges might be leased for periods not exceeding ten years, giving preference to municipal purposes. In many of our existing reclamation projects hydroelectric power development at the dams or drops in canals is used by the United States in the pumping of water to lands above the gravity canals, and in other projects power or power sites have been leased to private individuals or corporations engaged in similar irrigation of high lands.

Cheap electrical power will be of vital importance in another respect in those reclamation projects where drainage becomes necessary and where it is not feasible to reach and drain all of the water-logged lands by gravity, pipes or ditches. For with cheap electric current present it will be entirely practicable to drain and keep drained these low-laying areas which would otherwise be rendered worthless.

A practical illustration of the utilization of water and power resources is given in a recent paper by Frank G. Baum of San Francisco, where a power company in California stores flood waters in a high dam at an elevation of over 5,000 feet above sea level. After being released from the dam the water passes through a series of six power houses, utilizing a total drop of 4,140 feet for power purposes, generating more than 100,000 constant horsepower, the water being discharged from the last power house into irrigation canals which will accomplish the irrigation of more than 60,000 acres of arid lands.

One of the advantages of pumping by hydroelectric power is that the energy may be furnished by a large distributing plant which supplies the whole region and which will thus permit of dividing the work of irrigation among a number of successive stations, irrigating at the outset only those that are likely to pay, keeping pace with the natural growth of the demand for irrigation instead of tying up capital in a complete plant for a long period before it can become productive.

The irrigator whose lands are within the scope of an electric power development derives other advantages from the power so generated than the mere lifting of the water to his lands. The same wires which carry light for his house operate his threshing machine, sawmill, corn sheller and churn and eradicate much of the heavy and unpleasant labor formerly attendant upon farming. To the irrigator it means a steady and sufficient flow of water whenever desired and wherever pipes are carried uphill or downhill. There is no waiting for a "turn" at the water in a lateral which serves a half a dozen farmers. There are no annoyances from clogged or weedy ditches or broken canals or laterals; nor at the end of the irrigation season is it necessary to turn out to clean and put into condition laterals and canals in anticipation of the new season. Through clean open pipes, which will not clog with vegetation or weeds, which do not break or get tramped out of condition by livestock, a continuous flow of water reaches the exact spot in the farmer's field where it will do the most good, and continues to flow until the requisite irrigation has been accomplished.

The saving of water is an important and material result of the use of electric pumping of the pipes through which the water is forced, for it eliminates loss by seepage and evaporation. The experience of many irrigators had already fully demonstrated the value of these, to the west, most important uses of hydroelectric energy. But other developments and uses of this power upon the lands are of indirect interest to irrigation and irrigators.

Lack of markets or inadequate transportation facilities for his crops are enormous hindrances to the farmer of the west. This means not only loss and delay, but in some instances the total failure of his enterprise. The presence of an extensive development of hydrolectric energy in the irrigator's neighborhood may mean factories, manufactories, electrically operated railway lines, and a score of industries and enterprises which will attract to the vicinity a population which will require and take, at profitable prices, the produce of the land.

It is therefore of vital importance not only to the people at large but to the farmer upon the irrigated lands of the west that these resources be rapidly and fully developed, under such laws and restrictions, however, as will preclude this beneficent public utility from becoming a monopoly for the oppression of the people instead of their servant and aid to prosperity.

Far seeing statesmen propose to retain in the United States the ownership of these valuable power sites for the public lands and reservations, and to procure development through long time and definite leases, thus retaining such control over the future as will enable the American Congress of that day and generation to make new and proper legislation fitting those times and their needs, and thus insuring the greatest and most enduring good to the people generally, but particularly to those of us whose homes are in the west, and whose interests in water and its possibilities are direct and vital. With the full and wise development of the irrigation and power possibilities of the west, her opportunities for increased prosperity and well being are boundless.

Electrical People in the War Zone.

Later reports supplementing the information given in the last issue of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, relating to prominent electrical people who have been caught in the war zone and marooned abroad, indicate that H. H. Westinghouse is due to arrive in New York, Saturday on the *Celtic* and it is expected that Guy E. Tripp, chairman of the board of directors of the Westinghouse Electric & Manufacturing Company, is due on the same ship. Walter Cary, general sales manager of the Westinghouse Lamp Company, has been located in London, as has also N. F. Brady, president, and Arthur Williams, general inspector of the New York Edison Company. Gleason Wood is also in London. Frank Presbrey, the well known advertising agent, representing a number of electrical concerns, is in Stockholm. Nothing definite is known respecting the whereabouts of C. O. Baker, of the well known house of Baker & Company, platinum refiners, or Mrs. Baker. Col. Charles Ffrench, publisher of the *Musical Leader*, of Chicago, and formerly western manager of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, is in London at the Hotel Metropole, with Mrs. Ffrench and Miss Josephine Ffrench.

It is estimated that the available water powers in the province of Ontario, Canada, are capable of developing between 4,000,000 and 5,000,000 horsepower, of which less than one-fourth has been developed.

Electricity in Flour Mills.

By T. D. Rose.

This article treats very fully of the general features of the processes as found in large mills, with special reference to the advantages of motor drive, the selection of motors, etc. Extensive data are given on a large corn mill purchasing power from a central-station company.

The rapid advance in the improvements in the milling industry during the past few years has, like all other industrial problems, demanded some satisfactory solution of the question of power supply. The change from the old style grinding stones, that our forebears used, to the modern roller mill is the natural result of the increase in competition and the corresponding increase in the price of raw material, and has caused this class of business to join in the ranks of the wide awake manufacturers and seek some economical method of drive.

The old-fashioned stones formerly used were, in most cases, operated by water power from some equally old-fashioned water wheel. The capacity of such apparatus was necessarily small and, in order to meet the increased demand for the products and the growing competition, some economical changes, in methods of operation and apparatus used, were compulsory. With a continued growing field of supply, and a rising price of grain, the manufacturer had to give his attention to the efficiency of his apparatus and to the cost per unit of output. The application of steam power to the old grinding stones soon proved to be an uneconomical proposition, due to their inefficiency and exceedingly small capacity, and therefore new methods and more efficient grinding machines become a necessity.

Although these stone mills are used to some extent now, in the smaller plants, yet they are gradually giving way to those made of metal, capable of standing higher speeds and having less wear. The last named quality was a considerable improvement as regards depreciation and time expended in putting the stones into good condition again after short usage. We now find the metal roller mills capable of standing heavy strains and giving a better grade of product at a very efficient rate.

I have thus far spoken only of the improvements in the grinding machines, and although these machines alone consume approximately 60 per cent of the total power used in the mill, yet the various other machinery, such as cleaners, separators and purifiers have all undergone considerable improvement.

As an illustration of the increased efficiency along all lines, mills operating today with from three to four times the capacity as formerly, are requiring less men in the mill. At the same time the owners are paying from two to three times as much for raw material and are selling the products, in some cases, as low as one-third of the price.

In this article I desire to give the general features of the process as found in large mills, going into detail in the case of one corn mill, touching upon the advantages of electric motor drive, the selection and location of grouping of motors, and finally show the applicability of central-station service to such business.

Fig. 1.—Group of Degerminators in Corn Mill Each Driven by Separate Motor.

Fig. 2.—Group of 25-Horsepower Motors Each Driving Degerminator on Floor Above.

Whether the material used be wheat or corn, the process is, in general, the same, the object being to gradually break up the grain into its constituent parts and to separate these parts to form the various products of the mill. To accomplish this result, the process is divided into three general heads, namely, cleaning, grinding and separating. Each of the heads may have various sub-heads, such as drying, dusting, and again cleaning, grinding and separating, or in other words, the whole process consists of a series of cleanings, grindings and separatings, for after each separation, the tailings or bulky portions of the stock again pass over another series, until the desired degree of fineness is obtained. Thus starting at the head of the mill with the dirty grain as received from cars, the process is a continuous one, the products flowing out of the mill in a continuous stream. The material is in no instance handled by hand, being delivered in chutes by gravity and being raised again to the desired locations by bucket elevators.

Since, as stated above, the grinding mills consume approximately 60 per cent of the power used in the plant, it would be well to consider in detail the construction and operation of these mills. They are, as the name implies, cylinders of solid metal revolving towards each other at different rates of speed and whose object is to break, not roll, the grain into its various parts. To accomplish this, they are corrugated on their outer surfaces, and adjusted so that they do not touch each other in rotating. It is very essential that these adjustments be very accurate, the rolls being the same distance apart throughout their entire length, or otherwise the products will not be of

the same degree of fineness. Therefore, since each roll turns at a different rate of speed, the corrugations pass each other, and as the grain falls between them they break or tear it up into its parts. The rolls vary from 6 to 12 inches in diameter and from 10 to 36 inches in length, and have corrugations, depending upon the fineness of the material to be ground, of from 6 to 32 to an inch. To insure always a breaking effect, these corrugations are made in the form of a spiral of about one inch advance to each foot length, and the speeds of the rolls are in the ratio of about 2.5 to 1. A pair of rolls constitute a set or "stand," as it is called, and they may be either "single stand" or "double stand," the latter being preferable on account of the saving in space occupied to accomplish the same work. The power required to drive these rolls varies from two to five horsepower for the "single stand" and from five to ten horsepower for the "double stand."

In the operation of these machines they are divided under two heads, namely, "break rolls" and "reduction rolls," the duty of the former being to gradually break the grain up in order to remove the flour, and the duty of the latter being to reduce the flour to the desired fineness. They are usually grouped in the following combinations; four break rolls and six reduction rolls; or five break rolls and seven reduction rolls, the latter grouping being more desirable, since it is a mean between a too sudden or a too gradual breaking down, resulting, in either case, in a waste of power and a lowering of the quality of the products. Starting with the first break roll there is a gradual decrease in the size of the corrugations, for after each roll the material is sifted and bolted, the finer parts going off as certain grades of the product, while the larger particles are sent to the next roll, equipped with finer corrugations, to be still further ground. This method continues until the material is of the desired fineness. The operation at the "reduction rolls" is of the same nature, although the corrugations are much finer than used on the "break rolls," while in many cases these rolls are entirely smooth, a condition found more often in flour mills.

To accomplish the necessary handling of the material, during the above operations, there is, of course, a large number of bucket elevators, and both belt and worm conveyors. These have no special arrangement except to take care of the individual requirements of each mill. Thus, from the simple methods as formerly followed out in the old style grinding, the industry has developed into a very elaborate and complicated process.

In modern plants of large capacity, some place for storing the grain must be had in order to insure the mill against delays in shipment and fluctuations in the price of grain. This storing is usually done in large concreted steel tanks of capacities as high as 80,000 to 100,000 bushels. These tanks must be built so as to protect the grain from both heat and cold, as the former will cause it to sprout and thus reduce its value, and the latter will cause the moisture found in the new grain obtained during the winter season, to freeze. With such storage space the mill is sure of a supply large enough to insure its running for from ten days to three weeks, and is safe against weather conditions and fire.

The following is a description of one large corn mill with a capacity for grinding 9,000 bushels of corn each day of 24 hours, and is equipped with 31 motors, aggregating a total of 1,035 horsepower.

The corn is received in cars, each containing about 1,500 bushels, and weighing approximately 60 tons. The cars are delivered by the railroad company into the mill yard, but are left at a distance of about 50 feet from the unloading platform. From here the mill does its own shifting, being done by a system of ropes and pulleys actuated from a winch, driven by a 25-horsepower motor. This system pulls the loaded cars to the desired location and then pulls them away to make room for a new car. An actual test on this motor indicated that to start a car weighing 68 tons from rest required 25.2 horsepower; running after starting 18 horsepower; pulling the car a distance of 37 feet in 35 seconds.

After the car has been pulled up to the desired point, the unloading is accomplished by a couple of wooden shovels, working alternately from each end of the car. The shovels are actuated by two winches and two friction clutches, driven by the same motor that operates the car puller. To do this work, it requires 18 horsepower about one-half of which is friction. The corn is shoveled into the boot of a large elevator having a capacity of 3,000 bushels per hour, and raised to the top of the mill, a height of 90 feet. This elevator is operated, in conjunction with another of the same size, by a 35-horsepower motor, as shown in Fig. 3.

The grain as received is necessarily dirty, containing large and small particles of foreign matter. To remove these, the grain, after being raised by the elevator, is allowed to fall by gravity into a cleaner. This machine is equipped with a fan for removing the dust and with screens or sieves of various degrees of fineness,

Fig. 3.—35-Horsepower Motor Driving Elevator.

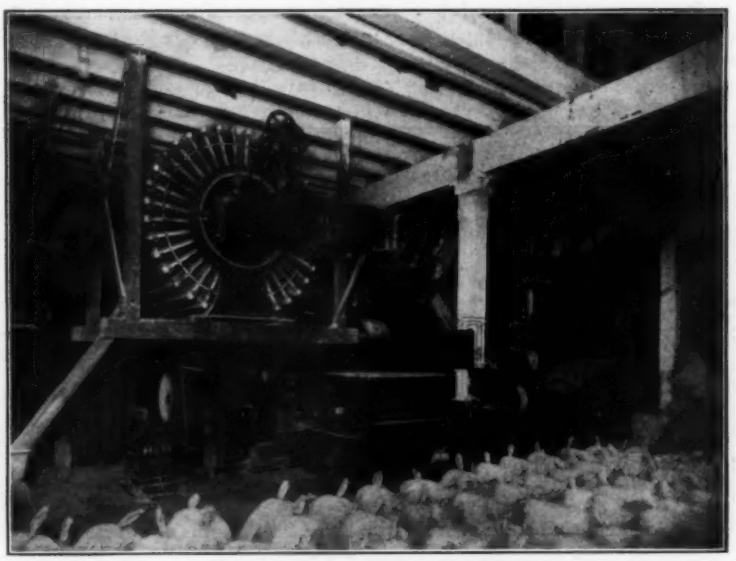


Fig. 4.—Motor-Driven Hominy Separators.

having a reciprocating motion and removing practically all foreign matter. The size of these machines varies, of course, with the amount of material handled by the mill, but the one in question has a capacity of about 3,000 bushels per hour and is operated by a 10-horsepower motor.

The grain next passes to the first part of the process. This step is the initial cracking, in what are called degerminators, shown in Fig. 1. Each consists of a conical shaped cylinder, having on its outer surface small points or knives, revolving in a similar shaped shell, also containing knives. The object of the shape is to afford by axial adjustment a break or grind of various degrees. These machines revolve at about 900 revolutions per minute and have a capacity of about 65 to 75 bushels an hour, depending upon the adjustment given by the operator. The plant in question contains seven of these machines, each being driven by a 25-horsepower motor, as shown in Fig. 2. The load on these machines is of a varying nature, on account of the irregularity in the flow of the grain, although every effort is made to insure an even flow. A test on one of the motors, with material flowing through the machine at the rate of 60 bushels per hour, indicated an output of 21 horsepower.

We now have the grain split up by the degerminators and therefore our next step is to separate the particles so that each may take its path to the foot of the hill. This is accomplished by what are called hominy separators, shown in Fig. 4. These machines consist of a set of revolving and shaking screens, working in conjunction with an exhaust fan, the object of the former being to separate the larger and smaller portions of the stock, while that of the latter is to remove the light portions, such as the husk and dust.

These hominy separators form the initial division of the stock, and from here the process continues to be more and more complicated. From the separators both divisions of the stock proceed to steam dryers, and before going further it would be well to give the function and reasons for the use of these dryers. The grain, as received at all times of the year, contains a certain percentage of moisture, varying from about 13 per cent during the summer to as high as 24 per cent during the winter months. The material, if allowed to reach the rolls in this condition will not be thoroughly ground. The moist particles, besides requiring more power to break them up, stick fast to the rolls, clogging up the corrugations and lowering the quality of the product. The dryers consist of a revolving drum made of two headers connected by small pipes, through which high-pressure steam passes, and over which the grain is allowed to fall. These machines require about three horsepower to operate them.

The husks and lighter portions after passing over the dryers are sent to centrifugal reels for separation, the husk and larger portions going off to be ground for "feed" and the lighter portion going off through rolls as different grades of meal. The "feed" as we will now call it, is next sent to the attrition mills for grinding. These machines consist of two heads revolving in opposite directions on which are bolted the grinding plates. They are made so that the plates can be adjusted to various distances apart for the different degrees of fineness. These machines are in different sizes as 22, 24, and 26-inch, meaning the diameter of the revolving heads, and require from 30 to 60 horsepower at about 1500 revolutions per minute. The feed from the attrition mills now goes to the packer for shipment.

The hominy or the heavier portions coming from the hominy separators, after passing over steam dryers, and cleaning apparatus, Figs. 5 and 6, now starts through the main part of the mill, namely, the "break rolls." Rather than go into detail again here the process is as follows: There is a series of four "breaks," each cracking the stock by a certain amount. After each "break" the material is separated or graded, by what are called "graders," into four parts. The finest portions go to the reduction rolls to be made into flour and fine grits. The next larger goes off as grits or hominy. The next larger goes to the next "break" to be ground to the fineness of the fourth break and going off finally as meal. The tailings, or the particles that have not been affected by the rolls, are the "germ"

Fig. 5.—Motor-Driven Separator.

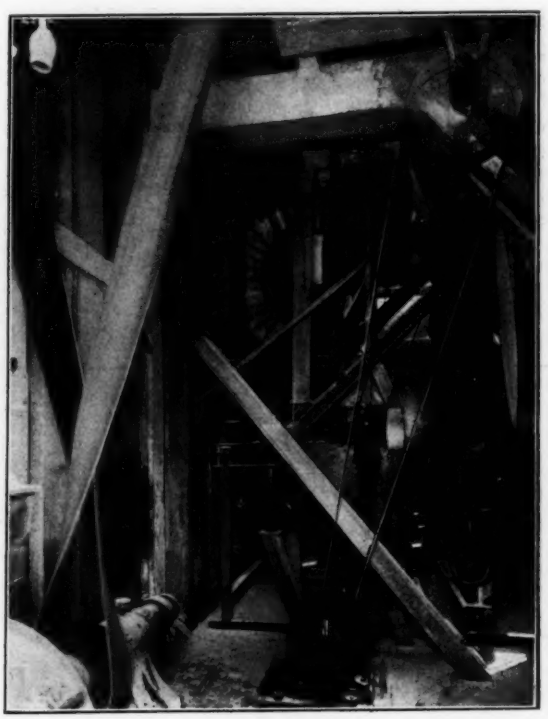


Fig. 6.—Motor-Driven Cleaner.

or oily portion of the corn and hence are too moist and soft to be cracked. These pass off through a roll equipped with round corrugations to an additional steam dryer. They contain about 20 per cent moisture, and in this condition are not fit for the oil press. The dryer reduces this moisture to about three per cent and delivers the germ to the oil press. The oil being removed, the cake or residue is passed through an additional attrition mill and passes off as "feed."

The stock referred to above as being passed to the "reduction" rolls goes through a series of six rolls, each roll reducing its fineness until it reaches the desired degree for the different grades of flour.

This mill is also equipped for the manufacture of corn flakes, which we might call a side issue, since it is really not a part of a hominy mill. After the stock has passed through the second "break roll," any or all of it may be diverted into the corn-flake department. This material is about twice the size of the product grits, and is fed between two smooth steel rolls. The rolls are pressed together with a pressure of from 20 to 40 tons depending upon the size of the flake desired. In some mills where the pressure is as high as 40 tons the flakes are exceedingly thin and are from an inch to an inch and one-half long. The rolls in this mill do not make such large flakes, and although no tests have been made to determine the pressure used, it is estimated to be about 25 tons. These rolls are all water cooled, and revolve towards each other at different speeds, 160 and 142 revolutions per minute. They are 20 by 24 inch and are driven by 35-horsepower motors, as shown in Fig. 7. The load on these machines is rather unsteady, varying from 20 to 40 horsepower, depending upon the pressures given by different operators.

Besides the machines mentioned above there are various blowers, dust collectors, cleaners and worm and belt conveyors. The number and use of these machines varies with the design of the mill, and therefore are not an integral part of the equipment.

In the applicability of such mills to electric motor drive there is one serious disadvantage, namely, the entire mill must operate as a unit. This fact makes the question of friction from shafting and belting a very serious drawback when compared to other applications where practically all such trouble can be eliminated by individual motor drive. A glance at Fig. 8 will give a good idea of the conditions. Each division of the mill is dependent upon every other division, so that if any certain group of machines, or in some cases, if any one machine shuts down, the entire mill must do likewise. Therefore, considerable trouble may develop by installing too many motors, going too far with individual drive since the greater the number of motors the greater the liability of a shut down. This question is best solved by grouping together on one motor the machines whose work is of the same character, or by grouping the machines on each floor. The design of the mill is usually such that a combination of both may be used. There are cases where it is advisable to use individual drive on machines such as cleaners, degerminators, attrition mills and flake rolls. These machines are usually arranged so that the shut down of one or perhaps two of them will not materially affect the operation of the mill and in such cases individual drive is recommended. The type of motor that is best adapted to such mills is the squirrel-cage induction motor, on account of its structure. There are instances, however, where it might be well to use the phase-wound motor, such as the roll line, where a rather heavy starting torque is required. In such instances the motor with the slip rings covered by a dust-proof shield is recommended. Unless it is absolutely necessary, direct-current motors are not to be used, but, if no other source of supply is available, the motors should be totally inclosed and arranged for ventilation.

Referring again to the question of friction, this becomes a more serious disadvantage where an old mill is to be changed from steam to electric drive. Due to the close relationship between one machine and another through interconnections such as chutes and conveyors, no great changes in the locations can be made. The millers have taken their locations more from a standpoint of ease in handling the stock than from

Fig. 7.—Flake Mills Driven by 35-Horsepower Motors.

Fig. 8.—Group of Motor-Driven Machines in Corn Mill.

a question of efficient mechanical drive, and therefore in old mills very troublesome obstacles will be found in the shape of idler pulleys and belt tighteners. These are all "power eaters" and should be done away with if the miller can be made to see the "error of his way."

The amount of power required for flour and grain mills depends upon the type of the product of the mill and upon the operators. Some millers work all their machines nearer their rated capacities than others, and some work their rolls much tighter, requiring more power. As stated above, about three-fifths of the power is consumed in rolls and grinding and two-fifths in the balance of the mill. The figures in Table I were made up by B. N. Dedrick and published in the "American Miller" as to the correct relations as to the power required between the various machines in a flour mill.

TABLE I.

	Per cent
Rolls	53.34
Cleaners	14.5
Sifters	3.66
Purifierfs and aspirators	6.16
Elevators and shafting	16.34
Reels	6.00

The divisions as to power consumed in the corn mill described above are given in Table II.

TABLE II.

	Per cent
Rolls and grinding	56
Grinders and separators	21
Cleaners and aspirators	3
Elevators	15
Miscellaneous	5

(Corn flaking machines not included)

The actual kilowatt-hour consumption depends, as stated above, upon the operators, but it has been found that in flour mills the consumption per barrel of flour is around six kilowatt-hours. In the corn mill described above the average has been approximately 1.6 kilowatt-hours per bushel of corn ground. This figure includes the flake roll department, so an effort was made to eliminate that division, since the usual hominy mill is not equipped for that product. The result was as follows: Running eleven flake rolls the output in four hours was 15,000 pounds of flakes, consuming 1,000 kilowatt-hours, or 15 pounds per kilowatt-hour. The mill running at this rate would make 14 pounds of flakes from each bushel of corn, and therefore the flake rolls would consume approximately one kilowatt-hour of the 1.6 kilowatt-hours per bushel of corn ground. Hence, the remaining 0.6 kilowatt-hour per bushel is used to crush the corn. Arriving at approximately this same result by another method is as follows: To operate the mill on flakes alone indicated a load of 250 kilowatts. To operate the entire mill indicated a load of 500 kilowatts; therefore, one-half of the power, or 0.8 kilowatt-hour was required per bushel to do each portion of the work. Figures found elsewhere on mills operating without the use of flake rolls consume from 0.6 to 0.8 kilowatts-hour per bushel.

The usual advantages that apply to motor drive in other classes of work will apply here equally well. Although, as stated above, the mill must operate with a large amount of friction loss, yet, by the installation of motors, at least 20 or 30 per cent of this loss experienced from steam-engine drive can be eliminated. Among the more prominent advantages are: reduction in fire risk, increased production, saving in belting, individual control of machines in case of chokes, thus realizing a saving in time, ability to control at a distance and finally the advantage of being able to shut down entire mill quickly in case of emergency.

The reduction in fire risk has a most direct bearing on the cost figures. In regard to this reduction, one writer says the following: "The frequency with which fires occur in the flour mills is a source of much concern to mill owners, and any method of reducing the enormous loss sustained each year will meet with hearty approval." This reduction is even more pronounced where central-station service is used and the adjacent boiler plant can be eliminated. Cases are cited where, by the application of electric drive, reduction in insurance rates as high as 30 per cent have been experienced. The corn mill described above has experienced a reduction of approximately 12.5 per cent since the adoption of electric drive, amounting to about a $300 annual saving.

The question of increased production is one that is hard to impress upon the millers, since they cannot see how the installation of motors can have any bearing on the question. This advantage is realized through numerous channels, such as, constant speed, ease of shutting down and starting up machines in case of chokes and, therefore, a saving in time and material; less time lost through shut downs to repair belting and other parts of the mechanical transmission and finally sufficient power to operate up to the entire capacity of the mill. This last point is realized in the case of a change over from old steam-driven mills. These mills when they first started running from the engine, in all probability, had sufficient power, but as time goes by the engine becomes weak with old age, and the mill has usually grown by the addition, now and then, of more machinery, until the point is reached where an attempt to put on the entire load results in an overload on the engine. This point has been brought out very forcibly in one corn mill by the fact that with the old drive they could operate the main portion of the mill only during the summer months, or dry season, and produce as a side issue only 250 bags of corn flakes per day. Since the application of motor drive they have sufficient power to operate the entire mill during the whole year, and also produce 650 bags of flakes per day, an increase in flakes alone, of 400 bags per day.

As an illustration of the saving in belts, I cite an instance of individual motor drive. The machines spoken of above as "degerminators" were formerly driven from a main line shaft by a system of double belt tighteners. A choke in one of these machines is a daily occurrence, either from too much material being fed in, or from some hard material such as metal, falling into the machines. Such an occurrence meant in every case a hurry call for the operator to loosen up the belt tightener. This required some time since the tighteners were located on the ceiling of the floor below the machines. If the operator was slow or the choke was very severe, it always resulted in a broken belt. This necessitated, in some cases, a complete shut down of the entire mill to repair this one belt, meaning a loss of an hour or so. The present arrangement, with a motor on each machine, entirely eliminates this loss in belting and in time. The motors are equipped with overload relays, and since they can therefore be set for any desired load, the operator can adjust his machine to throw out on all chokes above any certain point, thus shutting down only that one machine. The owners state that they expect a saving of approximately $300 a year in belting alone on this one group of machines.

Another instance of saving under this same head, is the direct-motor-driven attrition mill. This mill is used for many purposes, such as, grinding shelled corn, oats, cotton-seed cakes, feed and oil cake. As stated above, these machines consist of two heads running in opposite directions, on which are bolted the grinding plates. The distance between the grinding plates is determined by the degree of fineness required, and is obtained by an axial adjustment of the shafts. It is very essential that the plates be the same distance apart throughout their entire grinding surface to obtain a uniform product, and when in this condition are said to be "in tram." The idea was conceived to apply motors directly, but considerable trouble was experienced when the machines got "out of tram," due to the shifting of the position on the rotor, and changing the air gap. This has been obviated by two different methods, one by mounting the bearing and stator on the same piece, so that any movement of the bearing to put the mill "in tram" resulted in a movement of the stator also; the other by making a mill that is always "in tram." This latter is accomplished by the use of ball bearings,

having no wear, so that once the machine is set, it requires no further "tramming." It was, however, necessary to make the iron in the stator wider than that in the rotor, to take care of the axial adjustments for different degrees of fineness of the stock and cause no magnetic pull when the rotor is shifted one way or the other. Another advantage of this mill is the ease in reversing the direction of rotation of the grinding plates. With the belt-driven mill from line shafting this is impossible. By simply installing a double-throw switch in the motor circuit this reversing can be accomplished in a few seconds. The importance of this is found in the fact that when the plates run continually in one direction the knives wear down only on one edge. If the direction of rotation can be reversed, advantage can be taken of both edges of the knives resulting in practically doubling the life of the plates. The practice is to run the machine for a short time, say one week, in one direction and then in the other direction for a short time, producing an even wear on the knives. The use of ball bearings also results in a reduction of power required to drive the machine. An analysis of the saving resulting from such an equipment is as follows:

$75.00 per year in belting, etc.
$78.00 per year in grinding plates.
20 per cent saving in power consumed.

The ability to control at a distance, and ability to shut down the entire mill quickly in case of emergency are realized in cases of chokes. As stated above, there are instances where the shutting down of one portion necessitates similar action by the entire mill. When this complete shut down cannot be accomplished quickly, the operation of part of the mill, while the other is at rest, results in a piling up of material at the idle machines, which continues as long as any portion runs. Thus by shutting down all machines quickly, at one time, there is a considerably smaller amount of material lost by this piling up, for all operations cease at the same time. This can be accomplished by the use of a remote-control oil switch, placing push-button stations at various places in the mill.

Since, as stated above, the operation of the mill necessitates the running of practically every motor, the load curve from such a plant is almost a straight line. This insures at all times a comparatively high load-factor. Assuming average market conditions the mills will, in most cases, operate 24 hours per day, 26 days per month, and working on this basis will give a load-factor as high as 75 per cent, taking the average measured demand as the basis for the maximum load. The mill in question with a demand of 500 kilowatts and an average monthly consumption of 151,760 kilowatt-hours had an average load-factor of 49 per cent. The mill started during the middle of July, and had a low consumption for that month. During September and November the price of grain was very high, and that, together with the month of July, combined to give this plant a load-factor lower than the average. In a mill properly equipped with alternating-current motors the characteristics of the load will insure at all times a relatively high power-factor and the combination of high load-factor with high power-factor should make the load a very attractive one for the central station.

The U. S. Government census of 1910 shows that, although the use of electric power increased from 0.6 per cent in 1899 to 6 per cent in 1909, there is still a very large field open to the application of electricity. The figures for 1914 are only probable, obtained by extending the curves of the increase or decrease in the various applications. Although only 6 per cent of the power used was electric power in 1909, yet this report also states that 75 per cent of that power was purchased from the central station. With such figures as a background, with the many advantages obtainable by electric drive, and with the continued reduction in rates it should not be very long before the central station can place this class of business among those who have universally adopted its power.

Commercial Practice
Management, Rates, New Business

Norman B. Hickox.

No one questions the fact that spectacular electrical advertising is the strongest feature of modern methods of publicity, yet, the success of such advertising is dependent, in a large measure, upon individuality. Like all other forms of advertising, the demand—from a fickle public—is constantly for novelty, varied effect, distinctiveness and above all, individuality. With the coming of electricity into general advertising use, comes the need of the made-to-order display and into this branch of the industry has come a man, who in the short period of his association with the business, has made an enviable reputation as a producer and a live wire.

Norman B. Hickox.

Norman B. Hickox, treasurer and manager of the Greenwood Advertising Company, Knoxvile, Tenn., has done much for the electric sign industry by his untiring efforts in popularizing electrical advertising. Through the press, and personally, he has impressed on merchants and central-station managers the value of the electric sign and he has himself conducted many active campaigns in various sections of the country.

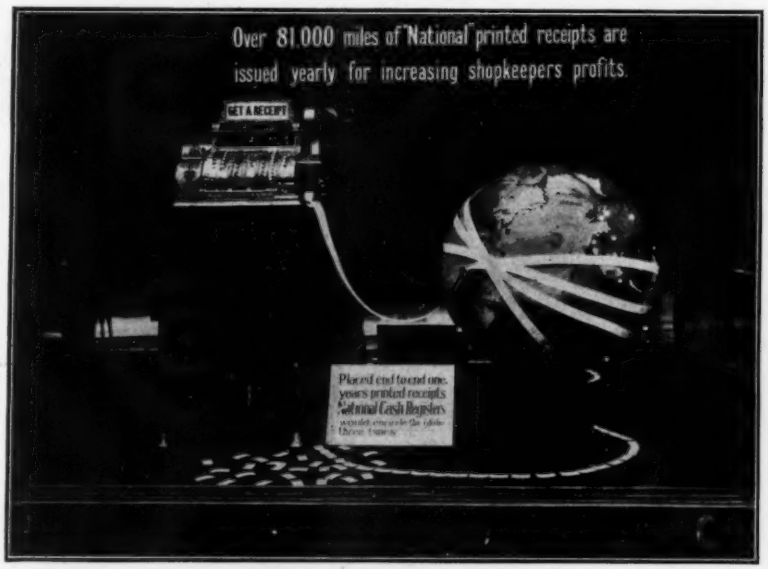
Mr. Hickox was born in Springfield, Il., in 1886, securing his education in that city. In 1903 he was employed by the Chicago & Alton Railroad for a brief period, when he entered the electrical field, under the tutelage of Emil G. Schmidt, general manager of the Springfield Railway & Light Company. After serving some four years as purchasing agent and secretary to the general manager of these companies in Springfield, he entered the employ of the General Electric Company, under E. L. Calahan, of the Chicago office. In traveling his territory for this company selling heating devices, he secured excellent promotion of his company's

product, and attracted the attention of S. S. Bush, of Louisville, Ky.

He was in the employ of Mr. Bush, as manager of the new-business department, during 1908 and 1909, and operated in DeKalb and Sycamore, Ill., Rome, Ga., and Jackson, Tenn., during that time.

In 1910, Mr. Callahan, who was at the time in charge of new business work for H. M. Byllesby & Company, Chicago, succeeded in sending Mr. Hickox to Muskogee, Okla., where his work in thoroughly electrifying the town from every standpoint was eminently successful. From there he came to his present work, that of the active management of the Greenwood Advertising Company.

Mr. Hickox is an Elk, is now a second-time Statesman of the Jovian Order, second vice-president of the Natonal Assocation of Electric Sign Manufacturers, and president of the Knoxville Advertising Club. His acquaintance among the electrical fraternity is very wide. He is a candidate for the Thirteenth Jovian Congress.



Electrically Operated Window Display.

Electrical Advertising Scheme in London.

The advertising department of the National Cash Register Company, Ltd., in London, is very fertile in novel advertising devices, all of which are worked out by the Company's own employees and given tangible shape in the workshops which are located on the third floor of the building which is the Company's London headquarters. Electric applications play a prominent part in these show-window schemes, which always attract a great deal of attention from passers-by.

One of the latest devices exhibited is a globe 4.5 feet in diameter and constructed of a wooden framework with a heavy paper covering, which represents the earth. The capitals of the various countries, and some of the largest cities, are indicated by four-watt lamps which are connected through the globe and its pedestal to the lighting circuit.

Around the globe a band of printed receipts is coiled three times, having its origin in a cash register standing on a stand near by. The interesting fact to which the advertising gives point is that the printed receipts turned out by National cash register in one year would encircle the globe three times.

All the cities indicated have central agencies of the Company.

Electric Fans For Hotel Guest Rooms.

The advantage to the hotel proprietor of placing a fan in each room for the comfort of patrons was first generally realized in the south and southwest. In the last few years the idea has spread rapidly, and each season has witnessed the installation of large numbers of fans in modern hotels in the central west where they were not formerly considered a necessity.

The newest St. Louis hotel, The Warwick, which opened its doors in July, is the latest example, of a hotel which provides a fan as a fixture in each bedroom for the free use of guests. This hotel is modern in every respect and the installation of fans was made as a matter of course to complete the first-class equipment of the building. The current issue of the *Emerson Monthly* contains an interesting commentary on the installation of fans in hotels which embodies some interesting suggestions to central stations desirous of building up a profitable business in this field.

It is interesting to note that the medium priced or so-called commercial hotels are taking the lead in the adoption of fan motor equipment, which is evidently demanded by commercial men who are quickest to realize the advantages of one hostelry over another. Many of the higher priced hotels have not yet realized the desirability of placing fan-motor equipment convenient to the hand of each guest, although some of them will supply fans on request, making a charge for the use of the fan in many cases.

It is hard to see on what basis a hotel guest should be asked to pay extra for the use of a fan motor. The hotel is presumably offering its rooms as livable quarters, summer and winter. American hotels make no extra charge for furnishing heat to guest rooms in winter, whatever may be the practice abroad of charging extra for "coals," so often complained of.

It is open to question whether, in many cities, the unfortunate hotel patron could not more comfortably survive the lack of artificial heat than dispense with the fan motor in his chamber. In cold weather he can, as a last resort, seek his bed for warmth, but the comfort of reasonable coolness can only be obtained by artificial breezes during many months of the year.

The time is certainly and rapidly approaching when in latitudes south of St. Louis and New York at least, the hotel which does not provide "the fan in every room" can lay claim to modern equipment no more than if gas were offered for lighting instead of electricity.

The sale of this equipment to hotels, new and old, will form no small part of the electric appliance business of the next five years. Central stations, contractors and supply dealers will do well to keep posted regarding projected hotel buildings and to canvass the field of existing hotels early each spring to secure this business.

Safety Meeting for Utility Employees.

The Utah Light & Railway Company, Salt Lake City, Utah, held a special meeting of all of its employees on August 12, at which E. M. Bagley, the company's claims attorney, and L. E. Abbott, commissioner of safety for the Oregon Short Line Railroad Company, and members of the Utah Light & Railway Company's Safety Committee gave illustrated talks and demonstrations on the "Safety First" movement. Two sessions were necessary in order to accommodate all of the company's employees.

Electric Cooking by Utility Employees Encouraged.

The Utah Light & Railway Company, Salt Lake City, Utah, has granted a 50-per cent discount from its regular cooking rate to company employees effective August 1, so that hereafter the employees may enjoy a rate of 2 cents per kilowatt-hour, subject to a 10-per cent discount for prompt payment and a minimum charge of $1.00 per month, for all electrical energy used for heating and cooking purposes.

The employees have enjoyed a half rate for lighting for several years. At the same time announcement is made that electric heating and cooking appliances will be sold to employees at a price just enough above cost to cover the expense of handling. General Manager Joseph S. Wells in announcing these special rates had this to say: "These special rates are granted to employees for the purpose of encouraging and stimulating the use of electricity for cooking and heating, and I hope that many will avail themselves of this unusually generous offer and cook with electricity, which will be found to be not only more convenient but cheaper than coal or gas."

Power Advertising in Springfield.

A convincing argument to power users is contained in an advertisement of the United Electric Light Company, Springfield, Mass., which points out that the use of electricity for driving machinery has the advantage over steam, in that when a manufacturer buys coal for his boilers he is not sure that the outlay will produce any definite amount of power; while in the case of electricity as the motive power, the bill for current represents the actual amount of power delivered and used—a quantity that does not vary, like steam, with the quality or condition under which coal is consumed.

The company's policy of sending an expert engineer to consult with manufacturers is in keeping with its policy of developing the load through home-wiring campaigns, cooking and heating installations, etc.

Iron Campaign in Boston.

The Edison Electric Illuminating Company of Boston, Mass., is conducting an electric flat-iron compaign during the months of July and August. An illuminated sign with letters five inches high, displayed in the show window of the appliance department, announces that "We will give you $1.00," which a placard, displayed just above, explains means that one dollar will be discounted in the purchase of a $3.50 electric iron of the latest type, on the purchasers bringing in any old iron, whether of the ordinary store type, or of charcoal or gas pattern.

A stand in the window presents a collection of a dozen flatirons of outgrown types, while below, on the sill, is a promiscuous heap of irons of every description that have been brought in.

Attractive Fan Display in Central-Station Window.

Imagine a pretty little lake, mirroring the evergreen trees along its mossy banks, its waters rippling in the cool northern breeze, and its icy purity being continually replenished by a trickling brook that tumbling over jagged rocks seems to have come just this moment from the mountains. Now imagine a cottage almost on the shore of the lake and imagine how cool and comfortable such a dwelling place would be. This is exactly the representation that was made this summer in the window of the Parsons Railway & Light Company, Parsons, Kans., with real water, and a real breeze from an electric fan rippling the surface into waves, and stirring the branches of the trees. "Cool Lake Breezes at Home," said a sign above the display.

Boston Edison Welfare Buildings.

With the opening of the library on July 20, the last of the group of Welfare Buildings recently erected by the Edison Electric Illuminating Company of Boston was thrown open for the use and enjoyment of its employees.

The buildings are a part of the group of service buildings of the company, located on Massachusetts Avenue, in the southern part of Boston. The Welfare Buildings consist of a recreation building and a restaurant and auditorium, besides the library. The structures form three sides of a quadrangle area, in the center of which is an open recreation ground containing three tennis courts. A 16-foot piazza runs the full distance around the court yard and is about one-eighth of a mile in length.

The architecture of the Welfare Buildings is distinctive. The construction is fireproof, the foundations being of concrete, and the walls of terra cotta blocks, with slate roofs. The outside finish is of stucco, and the inside of scoured plaster, the wood work being cypress.

Boston Edison Employees' Welfare Buildings.

On the left, as one faces the group, is the library, which is practically a club house, and is equipped not only with a large collection of books, but also with comfortable lounging and game rooms. On the upper floor of this building are 13 sleeping rooms, with up-to-date toilet facilities and shower baths. These sleeping rooms are for the use of employees whose work may hinder their reaching home for the night.

The recreation building is the central structure of the group. One of the rooms is the pool room and is furnished with three pool tables and one billiard table. A large brick fireplace is at one end of the room.

Another room is occupied by four bowling alleys of regulation size and the most improved equipment. In the

rear are the lockers, there being 200, of steel construction. Beyond the locker room are shower baths and the men's wash-room.

The auditorium and restaurant occupy the right-hand building. Tables to accommodate 500 persons at once fill the floor space. For use as an auditorium, the tables are removed and chairs arranged facing the stage which occupies one end of the hall.

The lighting of this room is obtained at night by means of four inverted bowls pendent from the ceiling on chains, and each containing a 750-watt nitrogen-filled lamp. A balcony at the rear of the hall seats 50 persons and gives opportunity for the operation of a stereopticon machine or spotlight.

When the use of the hall is desired for dancing, the canvas matting is removed from the floor, laying bare an excellent hardwood surface.

The service of the restaurant is on the "cafeteria" plan, except that waiter service is provided those who desire it, on payment of five cents a meal extra; while women employees, who have a private dining room, are given waiter service free.

The kitchen, which adjoins the dining hall, is equipped with two steam vegetable cookers and two 40-gallon soup kettles operated on low-pressure steam from the central heating plant of the service station. Apart from these, the equipment is entirely electrical, there being a large flat-top range 9 by 3 feet in surface area, having 12 three-heat switches equipped with pilot lamps.

There are also two large ovens, cup and plate warmers, coffee urns, automatic egg boilers, and electrically-heated serving tables and food cabinets.

The circuits for the kitchen are controlled from a service panel located in the steward's office. The same panel also controls the lighting service of the three buildings. Last month the Co-operative Development Committee of the Edison Company gave a dinner in the restaurant to 350 mayors, selectmen, aldermen and members of boards of trade from all the cities and towns comprised in the company's territory. The food was entirely prepared in the kitchen by the employees of the establishment.

While the buildings are open daily from 7 a. m. to 10:30 p. m., the dining hall is open day and night without intermission. The kitchen is open for inspection at all times, and is used as a model kitchen by the sales department in showing customers the advantages of cooking by electricity.

The rules regulating the conduct of the Welfare Buildings provide that no liquors shall be allowed upon the premises, and that no games shall be played for money. Lockers are charged for at 25 and 50 cents a month, or $1.50 and $2.50 a year. Bowling is five cents a string, and the rate for playing pool and billiards is 30 cents an hour, and for tennis five cents per person for each half hour.

Employees may bring guests, provided the same person is not introduced oftener than once a month. Books are loaned to employees free, and newspapers and magazines are supplied in the lounging room. Stationery is provided without charge.

In addition to the tennis grounds, there is a baseball field at the rear of the service buildings, and it is planned to erect bleachers at an early date.

The Boston Edison Company, by the inauguration of a comprehensive scheme of welfare work among its employees, is one of the pioneers among large central stations, and the admirable plant just now put in service is bound to serve as a model for companies in other cities of the country.

Boston Edison Welfare Buildings—Service Buildings in Rear.

Continued Success of Louisville Campaign.

With 126 contracts signed during the five and a half working days, the Louisville Gas Company on August 8 closed the best week it has had in the house-wiring campaign which it has been conducting in Louisville, Ky., and vicinity since the first of the year. This brings the total number of new customers obtained by the company's force up to 1,351, while representatives of independent contractors, it is estimated, have been successful in obtaining similar contracts for wiring other old houses to nearly the same number.

The contracts signed last week by the salesmen of the company represent an outlay of $6,702.10 for installations, and it is estimated, will yield an average monthly revenue to the company of $1.50 in each case. The total outlay for the installations for which the company's salesmen have written contracts since the campaign began, have reached a total of $65,945.50.

So successful has the house-wiring campaign proven that the company has just begun on an extensive scale a similar gas-heating campaign. Like many other electric concerns, the Louisville company combines an electrical and gas service, and other companies in the same situation will be interested to learn that the Louisville company is basing its gas-heating campaign on the same lines as its house-wiring campaign. The same contracts, revised only so as to specify gas or gas service where electricity or electric service was named before, are being used by the salesmen.

Robert Montgomery, manager of the commercial department of the Louisville Gas & Electric Company, said that he had found many of the same selling plans that have been in use in the house-wiring campaign will serve the company equally well in the gas-heating work.

Electric Sign Data

Slogan Sign at Wausau.

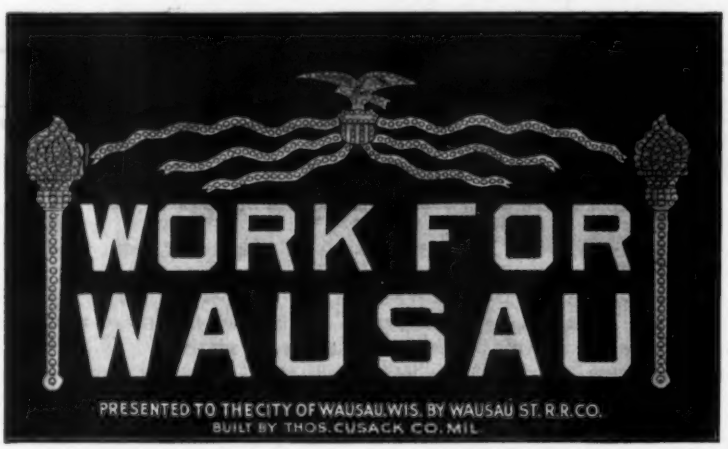
Wausau, Wis., known as the "metropolis of the Wisconsin Valley," is one of the latest converts to the rapidly growing list of cities having electrical slogan signs. The Wausau sign is noteworthy in many ways, particularly as it is one of the few slogan signs which, besides the local boosting idea, contains a feature of patriotic, national significance. The flashing white letters in the center spell out the inspiration which should help in the advancement of Wausau. The eagle and coat of arms of the United States carry with them the national idea, making a combination which is at once inspiring and patriotic.

The sign is erected at the end of the main street of the city on the roof of the new City Hall building. It consists of a single-faced galvanized-iron and steel structure with the slogan "Work for Wausau" in the center. This slogan was selected from among several hundred submitted, as a result of a contest for a suitable motto, held by the local Advancement Association.

Above the letters is an eagle in the position of soaring, and holding in his talons the United States coat of arms, from which red, white and blue ribbons trail in a waving motion from the center to both extremities of the display. At each end of the sign are two brasers, with flaming torches in colors, with a natural flame waving motion.

The sign was presented to the city by the Wausau Street Railroad Company, of which M. C. Ewing is the general manager. On the evening of the formal presentation ceremonies the crowd that assembled numbered 15,000, which is said to be the largest gathering ever seen in the streets of Wausau at one time. Mr. Ewing delivered a brief address, urging the citizens to live up to the spirit of the slogan. A representative of the city acknowledged acceptance of the gift and thanked the company for its kindness and good wishes.

The address of Mr. Ewing voices the cordial relationship that exists between the utility and the public—a relationship that should exist in every locality. In the course of his remarks he said: "One gentleman proposed to our committee as a slogan "The City Harmonious." That was a splendid suggestion and would have made a good slogan for it well represents the spirit of this city on all public matters, but our adopted slogan is still a better one as it will teach us all a lesson which all should know, and particularly our young men, and that lesson is that it requires work, and united work, to build and maintain Wausau as a metropolis of the Wisconsin Valley. We want Wausau to grow larger and greater than it now is. We want no less than 25,000 inhabitants in 1920, and we not only want them, but we propose to have them." Such an attitude on the part of a central-station manager is bound to work for the permanent good of the company and the community.



Slogan sign built by Thomas Cusack Company, of Milwaukee. Sign is 40 feet long by 38 feet wide.

Contains 976 five-watt tungsten lamps.

Wording "Work for Wausau" is in 48-inch and 60-inch grooved block letters.

Flashing effect is as follows: First, the eagle and ribbons come on, and are immediately followed by the torches, which are followed at an interval of 15 seconds by the wording "Work for Wausau," then all out, all on at once, all out, and repeat as before.

The colored effects produced by means of color caps are: Eagle and body of torch handles amber, the latter studded with ruby, green, and blue jewel effects. The shield and ribbons are red, white and blue; the flames red and the letters are all white.

Pottsville, Pa., is another wide-awake city, which has recently erected a slogan sign. The sign in this case is 20 feet long by 20 feet wide. On top is the outline of Schuylkill County. with a spot showing the location of Pottsville and the name "Pottsville" inside of the outline. On the upper left-hand corner is "1811," and in the lower right-hand corner below the outline is "1914." Underneath the outline of the sign in 24-inch letters is the slogan "The Best Site in the Anthracite."

This sign is erected on top of a large department store building facing the two railroad depots. The Eastern Pennsylvania Railways Company supplies the necessary energy.

Electric signs containing more than 32 square feet of space cannot be erected in St. Joseph, Mo., without first obtaining a building permit. The fee for minimum size sign is $1.00. Existing signs are not affected by the law.

Electrical Construction

WIRING DETAILS FOR LIGHTING OF GILBERT AVENUE VIADUCT.

By Kenneth C. Cardwell.

When the city of Cincinnati, O., by the construction of the great concrete viaduct which now spans the distance from the foot of Gilbert Avenue to Eighth Street, eliminated the necessity for the heavy traffic from the residential hills to the business section of the city of going far around or of crossing at grade a number of railroad tracks, the problem of lighting the 1100-foot stretch of the big viaduct naturally arose; and, properly, it was considered and taken care of in the construction of the viaduct, forming a part of the initial construction.

For example, the structure itself being of reinforced concrete, the forty standards which bear the lights for it were also made of concrete; and they were a part of the work contracted for. Also, the conduits which bear the wires from the distributing point to the lights are in every case carried within the concrete structure, being thereby protected to the fullest possible extent. In consequence, the system is not only modern, but in outward appearance, as exemplified by the light standards, it is entirely harmonious with the structure itself.

The standards were cast in two parts, on the ground, being placed in position after completion. The column, octagonal in shape, fifteen inches in diameter at the base, and tapering thence from nine to eight inches at the top, was in one piece, while the top piece, consisting of cross-arms designed to bear four inverted globes and one center globe, was the second piece. The forms used were of wood, and the work was turned out in remarkably good shape, making the standards handsome in appearance. The total height of the standards, from the top of the rail to the center of the upright globe at the top, is 8.5 feet, the total height above the level of the viaduct being greater by the height of the rail on which the standards are mounted, which is 3.5 feet.

Each standard carries in its center a two-inch galvanized iron pipe, which was placed in the wood mold before the concrete was poured, thus causing the pipe to form an integral part of the column. Each pipe serves as a conduit through which the wires are carried to the lights from a service conduit in the concrete rail of the viaduct. The connection between the conduit in the standards and the service conduits are made at a point several inches below the level of the railings of the viaduct by means of specially constructed boxes. The upper section of each standard was also poured with the conduit in place, the two sections of each standard being screwed together when erected, thus giving the appearance of a solid monolithic standard.

The details of the boxes used to joint the conduits in the standards to the service conduits are shown in Fig. 2. Each is provided with an Edison two-pole plug cutout and with a bronze door facing the driveway so that inspection and repairs can readily be made. The cutouts permit any lamp to be cut out of the

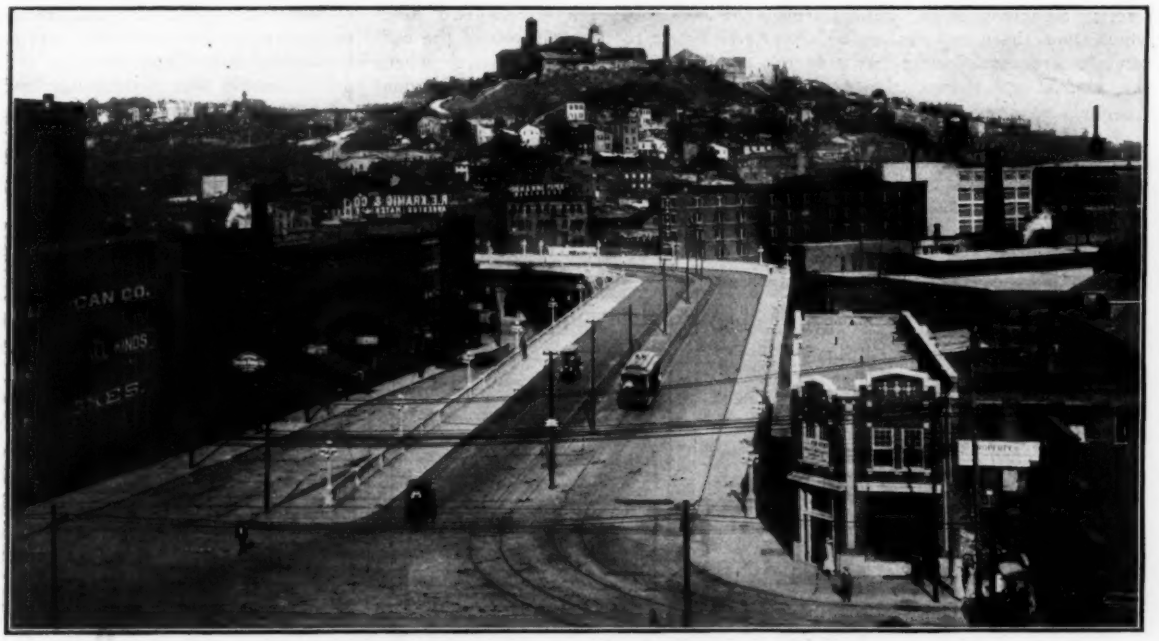


Fig. 1.—A View of the Completed Viaduct.

circuit when desired, and the whole system is so arranged that if at any time the city desires to provide for the use of only a limited number of lights it can do so.

A three-wire system of distribution is employed throughout, the current at present being obtained directly from the city's mains. The viaduct

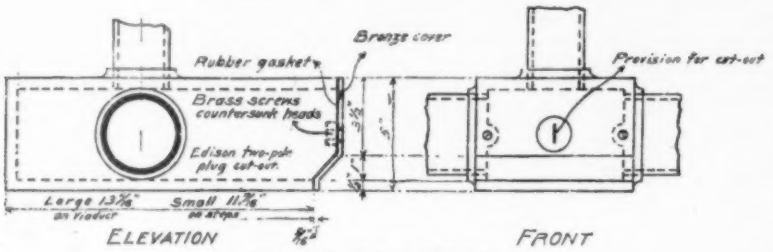


Fig. 2—Section of Pull Box.

circuits are fed near the center of the structure, the connection with the city's mains being made through the column of one arch as shown in Fig. 3. The service feeders are carried directly to a distributing cabinet from which two three-inch galvanized-iron conduits are carried to either side of the viaduct as shown, the conduits

conduits are run several inches below the top of the viaduct rails. At newel posts 17A and 17D, where connection is made with the supply mains, junction boxes are employed. At these newel posts there are no lighting standards, the standards as a rule being placed on every fourth post. The absence of standards on these newel posts hence permits access from the top to the junction boxes at these newel posts.

This access is rendered possible by running a short length of three-inch conduit from each of the two junction boxes to near the top of the corresponding newel posts, where threaded bronze caps with hexagonal

with bronze doors and rubber gaskets, thus rendering possible access to the boxes from the side as well as the top.

Three-wire circuits of No. 4 standard double-braided okonite wire were used throughout except where the specifications called for lead-covered wire.

Each post carries five Alba globes, each containing a 60-watt Mazda lamp. Each center globe is 14 inches in diameter, and each of the four other globes which are inverted at the ends of the cross-arms is ten inches in diameter. The globes were purchased by the city direct from the manufacturer, but the lamps formed part of the contract for electric wiring. The job was handled by the Devere Electric Company, of Cincinnati, O., and total cost to the city for all electrical contracting work was $2,650.

As completed and in use, the lighting system of the viaduct makes that structure one of the best lighted places in the city. While the standards are 60 feet apart on each side except at the ends, where the distance is reduced to 45 feet, the illumination

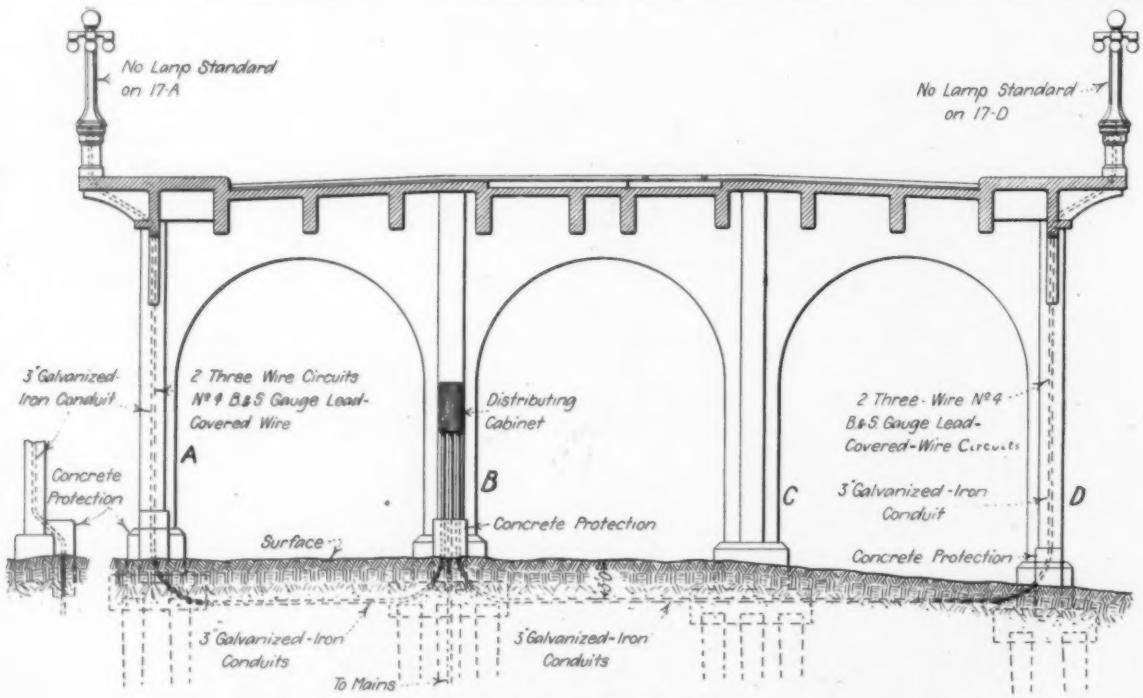


Fig. 3—Section Through Viaduct.

being imbedded in the concrete and fully protected at all bends. Each of these conduits contains two three-wire No. 4 lead-covered cables.

Distribution is made from these feeder circuits by means of circuits carried in three-inch fiber conduits, each three-wire circuit supplying one-half of one side of the viaduct. These

nuts are employed to cap the corresponding conduits. Access to these junction boxes from the top of the rails is hence readily obtained by removing these caps. These junction boxes, like all those employed on newel posts carrying standards, are carried to the inner side of the concrete rails where they are provided

given by the five lights on each is ample for all purposes, and this is true even at the Gilbert-Avenue end, where a concrete retaining wall on the south side gives room only for four lights on each of the three standards there, the outer light bracket being eliminated on account of lack of space.

INTERCOMMUNICATING - TELEPHONE SYSTEM INSTALLED IN EVANSTON HOSPITAL.

A Central-Energy Metallic Push-Button System.

An elaborate intercommunicating-telephone system was installed in the new contagious building of the Evanston (Ill.) Hospital, of which a description of the electric wiring for light, power and nurses' signal system was given in our issue for August 8, 1914.

The telephone system is of the 22-station type, with a superintendent's call and was supplied by the Stromberg-Carlson Telephone Manufactur- Company, Rochester, N. Y.

Meyer J. Sturm, Chicago, was the architect, and L. H. Lamont & Company, of the same city, was the electrical contractor.

In this system each station is provided with a push-button switch for every other station in the system and an answering button. The station buttons are of the three-position type. In the first or normal position none of the push-button contacts are closed. In the second position the button contacts for the talking wires leading to the station corresponding to the push-button are closed. This position can be held without retaining one's finger on the button. In the third position the button also closes the bell-signal circuit corresponding to that button. This position can only be held by pressing on the button, for as soon as the pressure of one's finger is removed a spring causes the button to assume the second or talking position.

To call another station one must first remove one's receiver from its hook and then fully depress the push-button corresponding to the station desired. As long as one's finger is retained upon the push-button the bell at the station being called will ring unless its receiver is off its hook.

To answer the call, the receiver is taken off the hook and the answering push button depressed. The talking circuits are thus completed and conversation may be carried on. When conversation has been completed the receivers at the two stations are placed on their hooks and both stations are ready for the reception of other calls. The buttons that were depressed at the stations are not automatically restored to normal position when the receivers are replaced upon their hooks, but are automatically restored upon depressing any of the other buttons for the purpose of sending or answering a call. To accomplish this the push-buttons are so arranged that only one can be in a depressed condition at one time.

With the system installed it is possible for each station to call any of the others at any time except when the receiver for that station is off of its hook, as would be the case when the station called is being used. At such times the signal bell for the station called will not ring.

Fig. 1 shows the wiring diagram for a three-station intercommunicating system of this type, the number of stations being limited to three in this description in order to simplify the connection diagram. With this diagram it will hence be possible to explain in detail the operation of the installed system. This and the other diagrams used for illustrating this article have been simplified as much as possible and are not designed to show the actual mechanical construction of the various parts of the sets but merely the circuits for the system.

Signaling Circuits.

Fig. 1 is drawn with the receiver of stations *2* and *1* off their hooks and with the receiver of the other station on its hook. Station *3* hence represents a station from which a call is about to be sent. For the purpose of description let it be assumed that the person who has removed the receiver of station *3* off its hook desires to communicate with station *2*. Having the receiver off its hook the push button *2* of station *3* must be fully depressed. This will close the signal-bell circuit for station *2* causing the bell at station *2* to ring.

Tracing the signal circuits it can readily be seen that current will flow from terminal *B* of the signal battery to the contact located on the push button at the various stations. Now since push button *2* of station *3* has been fully depressed a connection will be made from wire *A* through the contact member *x* of this push button to the spring *R* which is connected to the wire *H*. At the point *T* wire *H* is connected to another wire leading to one terminal of the answering button of station *2*. To this terminal is also connected a wire marked *W*. Hence connection is made from wire *H* through *T* to wires *W* and *X*, and from *X* through the signal bell of station *2* to a contact member on the hook switch. As the receiver is on its hook this contact member makes contact with another member which is connected to wire *A* from the battery thus completing the signal circuit. The signal bell at station *3* from which the call was sent will not ring because its circuit is open at its hook switch due to the fact that the receiver has been removed and also because wire *Y* which is dead and not *H* forms part of the circuit. Similarly the bell at station *1* will not ring because it is supplied through wire *Q* and the receiver is off its hook.

Fig. 2 which shows merely the signal circuits for the condition assumed, namely, that station *3* is calling station *2* makes the tracing of circuits somewhat easier.

Talking Circuits.

Suppose now that the call has been heard at station *2* and the receiver taken from its hook. The hook-switch contacts for the signal circuit break contact thus opening the signal-bell circuit which is also opened at station *3* as soon as one removes his finger from the button. When the receiver of station *2* is taken from its hook the other contact member of the hook switch of station *2* will assume the same position as the corresponding one of the calling stations. When the answering button of station *2* is depressed the talking circuits are completed.

Before tracing the talking circuits it will be well to refer to Fig. 3. This diagram shows merely the circuits required for talking between stations *2* and *3*, station *3* being assumed to be the calling station. The letters *B* to *I* inclusive and *K*, *L*, and *W*, of this figure correspond to the wires and parts similarly labeled in Figs. 1 and 2. It should hence be remembered that a talking wire (*H*) was utilized as a signal wire for signalling from station *3* to station *2* and that the wires shown in dot-and-dash lines in Fig. 1 are the only additional wires required for signalling.

Referring to Fig. 3 it is seen that the wires *F* and *W* from the talking battery are connected through impedances *B* to each of the transmitters through the primaries of induction coils and receiver-hook contacts, causing the stations to be connected in parallel across the battery wires *F* and *W*. Each of the telephone receivers is connected to the secondary of an induction coil the primary of which is in series with the corresponding transmitter. Two wires *G* and *H* connect the two station circuits being connected to these circuits at points between the impedances and the hook switches. The connections to the circuit of the station called are effected through the contacts of the answering button while those at the calling station are effected through the contacts of the push button for calling station *2*.

Although the two stations are connected in parallel with respect to the battery wires *F* and *W*, the transmitters and the primaries of the induction coils of the two stations are in series with each other through the talking wires *G* and *H*. When considering any telephone problem it must be remembered that although impedance or choke coils offer comparatively little opposition to the flow of direct currents of constant value, they do offer considerable opposition to the flow of alternating currents and to variations in direct currents. Bearing these effects of such coils in mind the operation of the telephone system that is being described can easily be understood without going into further theoretical details which would only serve to confuse the reader.

Assuming that a person is talking into the transmitter at station *2*, the vibrations

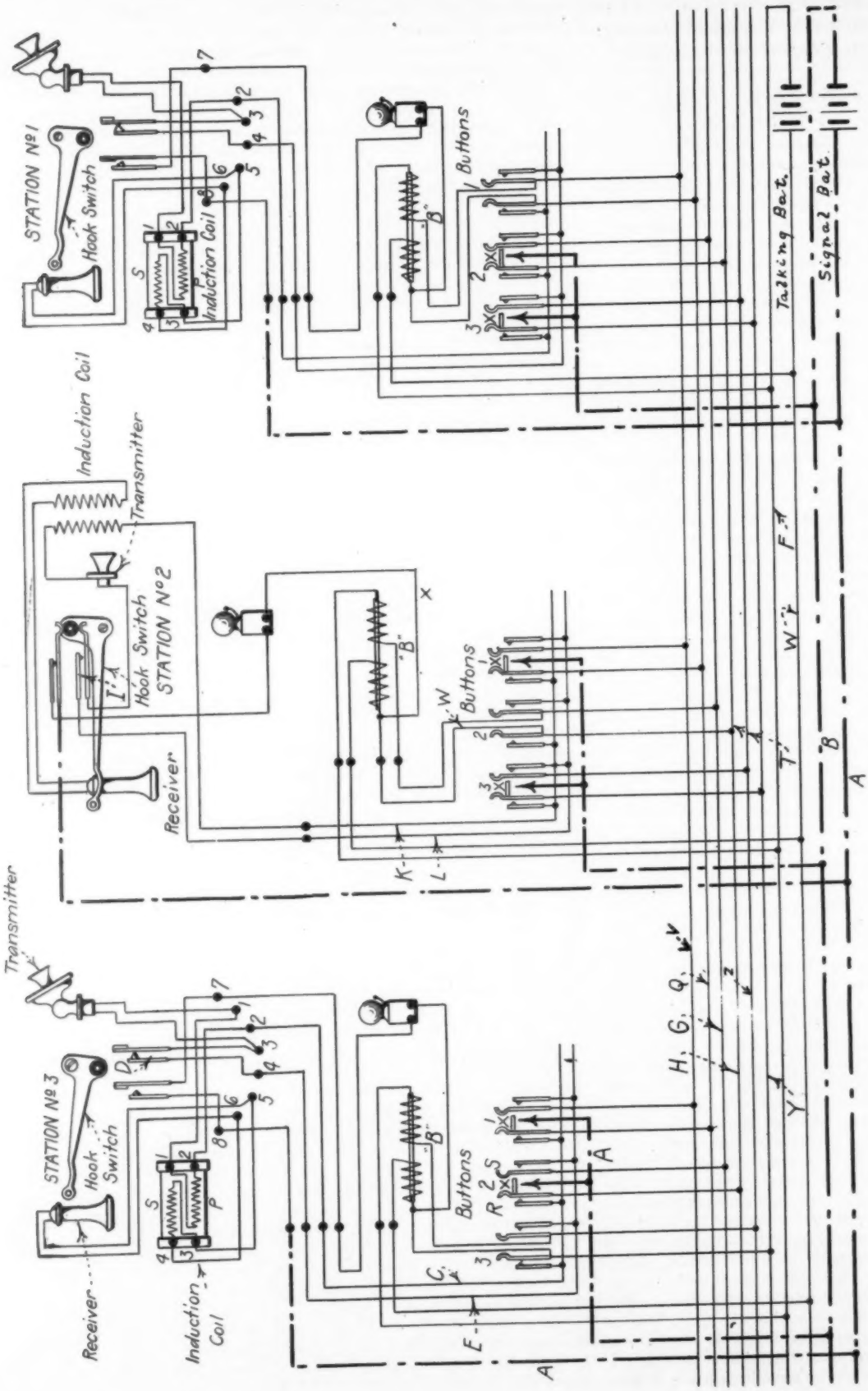


Fig. 1—Complete Circuits for Three Stations.

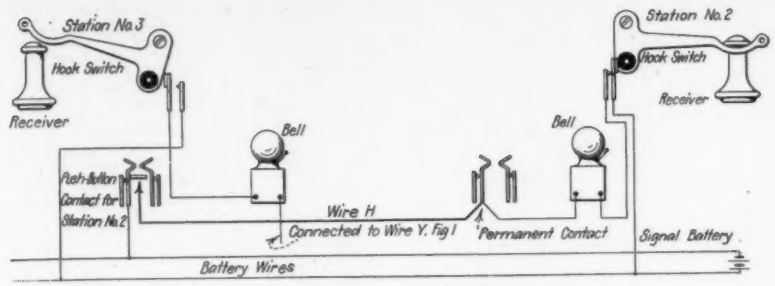


Fig. 2—Bell Signal Circuit.

of the diaphragm of the transmitter due to the incident sound waves will cause synchronous variations in the resistance embodied in the transmitter. This causes the direct current flowing from the battery wires through the impedance coils, the transmitter and the primary of the induction coil located at station *2* to vary in accordance with the variations in the resistance of the transmitter, and hence in accordance with the nature and variations of the sound waves incident upon the diaphragm of the transmitter.

These variations in the resistance of the transmitter will cause variations in the voltage drop across the terminals of the transmitter. Now the two stations are connected together by the wires *G* and *H* which are free of impedance coils. The wires *H* and *G* may and may not carry current when neither of the persons using the two telephone sets is talking but when sound waves are incident upon either transmitter the variations in voltage drop across the terminals of the transmitter will disturb the voltage relations in the circuit comprising the wires *H* and *G*, the two transmitters and the primaries of the two induction coils and will give rise to alternating impulses which are superimposed upon any direct current that may normally exist in the closed circuit considered. These alternating impulses vary in frequency and other characteristics with the nature of the sounds produced before the transmitter in use. Since these impulses are of the alternating type and of high frequency they will seek the path of less opposition through wires *H* and *G* as the alternative path through wires *F* and *W* contains impedance coils.

If the wires *H* and *G* normally carry no current as is possible these alternating impulses will pass through these wires as alternating currents but if the wires *H* and *G* do normally carry some of the battery current between the two stations owing to the resistance relations existing these alternating impulses will be superimposed upon whatever current exists and may give rise to a varying direct current or to alternating current depending upon the value of the direct current flowing. In either case the action is the same.

These alternating impulses in the circuit under consideration will reduce alternating currents in the secondary circuit of the induction coil of station *3* if some one is talking into the transmitter at station *2*. These currents passing through the magnets of the telephone receiver at station *3* will cause the diaphragm of the receiver to vibrate and reproduce the sounds made by the person talking into the transmitter at station *2*. Similar action takes place when the person at station *3* talks into his transmitter.

Turning now to the more complicated wiring diagram shown in Fig. 1, the means of effecting the connections shown in Fig. 3 will be explained. Considering first station *3* from which station *2* was assumed to be called, it will be noticed that the talking-battery wires *F* and *W* of Fig. 1 which correspond to the wires similarly labeled in Fig. 3 are connected through the impedance coils *B* and the terminals of the answering button of station *3* to the wires *C* and *E*. These wires lead to the terminals marked *2* and *4* to which the primary of the induction coil and the transmitter are connected in series through the contact *D* of the hook switch thus giving the connections for station *3* shown in Fig. 3 with the exception of the connections to the talking wires *G* and *H* for station *2*. The connections between wires *C* and *E* and *G* and *H* are effected through the contacts *R* and *S* of push-button switch *2* which was depressed in calling station *2*.

Having traced these connections it is now necessary to trace the circuits for station *2* on Fig. 1. It will be noticed that the talking-battery wires *F* and *W* are connected to the transmitter and the primary of the induction coil through wires *L* and *K* in the same manner as those for station *3* except that these connected are effected at the terminals of the depressed answering button of station *2*.

Now the connections of the talking wires *G* and *H* to the wires *L* and *K* should be made through contacts of the answering button because these wires are always utilized for talking whenever station *2* is the station called. It will be noticed that these connections are effected in the manner explained.

Circuits for the Complete System.

Having now traced the signal and talking circuits for two stations, the connections existing after a conservation has been completed and the operation of the entire system may be considered. As previously stated the push buttons at the various stations are not automatically reset when the corresponding receiver is replaced on its hook but a push button remains depressed until another station button on the answering button is depressed. Hence after the receivers of stations *2* and *3* are replaced upon their hooks the connections remain the same as they were during the period in which the telephones were in use except that the replacing of the receivers closes the bell-ringing hook-switch contacts at both stations and opens the transmitter circuits at both stations. The answering button of station *2* remains in the depressed condition and the push button *2* of station *3* remains in its second or talking position in which position the ringing contacts for calling station *2* are open for it must be remembered that the ringing positions of the various push buttons can only be held by retaining pressure on the push buttons.

Let it now be assumed that a person at station *2* desires to call station *3*. Removing the receiver from its hook he will fully depress the push button for station *3* thereby causing the depressed answering button to resume its normal or first position. As long as push button *3* is re-

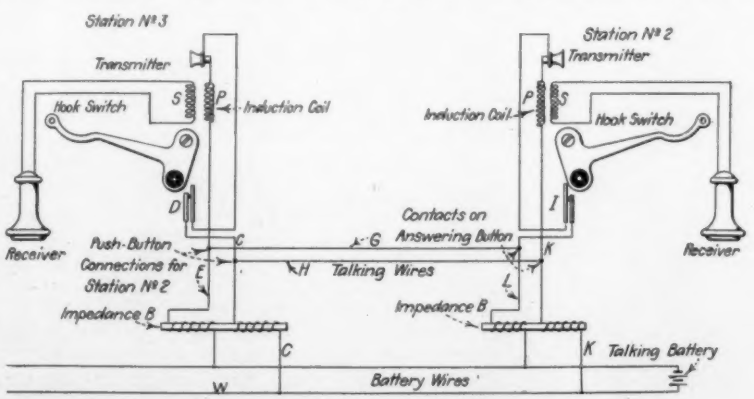


Fig. 3—Talking Circuits.

tained in the fully depressed condition the bell at station *3* will ring for the bell hook-switch contact of station *3* is closed owing to the fact that the receiver is on its hook. However, reference to Fig. 1 will show that the ringing current between stations *2* and *3* does not flow through wire *H* as it did when station *3* called station *2* but through wire *Y*.

When the receiver of station *3* is removed from its hook the ringing circuit is immediately broken at the hook switch and the talking contact at the hook switch closed. Pressing the answering button at station *3* completes the talking circuits which are similar to those formed when station *2* answered the call of station *3* except that wires *Z* and *Y* and not wires *G* and *H* are utilized as talking wires.

This immediately calls to one's attention that a pair of talking wires is provided for each station as shown in Fig. 1. The wires *G* and *H* are the wires employed when station *2* answers another station, the wires *Z* and *Y* are the wires employed when station *3* answers a call and the wires *V* and *Q* are the wires employed when station *1* answers a call. Wires *G* and *H* are connected to the answering button of station *2* and lead to button *2* of all the other stations on the system. The same scheme of connections is employed for wires *Z* and *Y*, and wires *V* and *Q* and for every other pair of talking wires that are employed in the 22-station system as a pair of talking wires is employed for each station on the system.

The description given of the operation of stations *2* and *3* as both calling and answering stations shows the principle of operation of the entire system. As long as the receiver of the station desired is on its hook any other station can call it by fully depressing the button for that station. The talking wires of the station called are employed for talking and one of these wires is employed for signaling. If a person at say station *10* is calling or talking to a person called at station *15* it will be impossible for any one desiring station *10* to ring its bell or to effect a talking connection as the bell-ringing contact of station *10* was broken upon removing the receiver and button *15* and not the answering button of station *10* is depressed.

However, if some one desires to communicate with station *15* it will be impossible for him to ring the bell at station *15* as the receiver at station *15* is off its hook but a talking connection will be effected owing to the fact that the answering button of station *15* is depressed thus connecting station *15* with its pair of talking wires. However, evidence will at once be had that station *15* is in use owing to the hearing of the conversation being carried on with station *15* and the calling party should hang up his receiver.

The use of separate talking wires for each station makes it possible for any station to call any other station that is not in use regardless of the number of stations on the system that are in use.

Superintendent's Call.

The superintendent's call comprises means for ringing the bells of all stations at once so as to be able to obtain the superintendent in the minimum amount of time regardless of where he may be at the time of a call. For this purpose a separate bell-ringing push button is provided at each station, the push buttons being connected in parallel and the bell-ringing batteries being used to supply the current. A relay which will operate upon the pressing of one of the buttons is included in the circuit. The operation of this relay will close the circuits to the signal bells of all stations. A prearranged code of signals may be employed if it is desired to use the system for locating more than one person or for other reasons.

Wiring and Stations.

As stated in our issue for August 8 all telephone cables are of the lead-covered type. Iron cabinets are employed throughout.

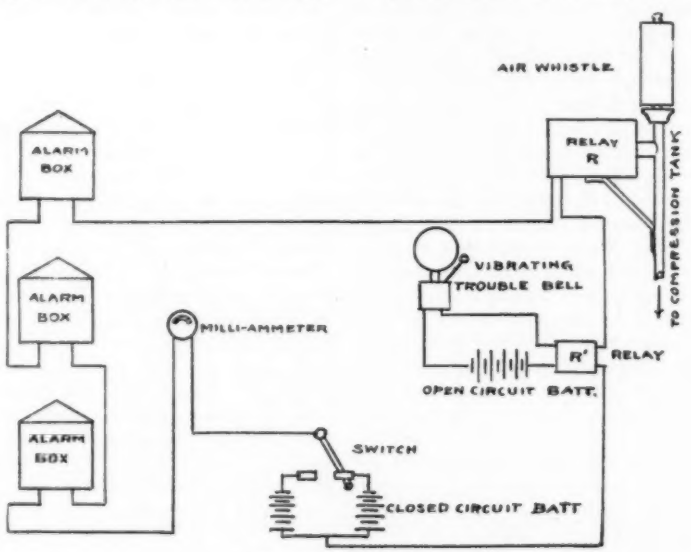
Most of the stations are of the wall type in which case the push-button panel forms part of the instrument cabinet. Where desk telephones are used a separate push-button box is located on the corresponding desk.

Lights on the forty standards erected on Capitol Boulevard between the Capitol and Church Street, Nashville, Tenn., were turned on last week, brilliantly illuminating that thoroughfare. It is now proposed that Eighth Street, between Church Street and Broadway, be similarly lighted and the city commissioners are considering the project.

An Unique Fire-Alarm System.

In the July, 1914, issue of *Safety Engineering* a fire-alarm system for factories is described which is of interest in that electrical means are employed for operating an air-whistle. Gongs are often employed for giving such alarm but considering the number required to give signals throughout a large factory, the item of expense of such an installation is considerable.

The diagram illustrates the circuits for the system described. The primary battery is in duplicate so that one battery will be in commission while the other is being recharged or repaired. The milliameter will indicate the condition of the batteries. The open-circuit battery will operate the vibrating trouble-bell when the local circuit is closed through the relay *R*. This relay will operate when the main circuit is opened, either accidentally or when a box is pulled. If there happens to be a break in the line the vibrating bell will ring continuously unless shut off or the trouble is remedied. In the same manner the whistle, which is operated by the relay *K*, will blow once each time the circuit is opened, consequently each box is equipped with a round disc with notches in it of a number and so spaced so as to cause the opening and closing of the circuit a certain number of times, thereby giving a distinctive series of blasts indicating which box has been pulled.



Fire-Alarm Circuits.

In general the relays should be of not less than 20 ohms resistance; the wire should be not less than No. 14 gauge, double-braid, weatherproof, and run in conduit. The conduit and boxes should be enameled red so that the wiring will not be disturbed by electricians who might mistake it for lighting or power service.

Safety-First Rules for the Electrician.

At the recent convention of the Southwestern Electrical and Gas Association at Galveston, Texas, F. N. Lawton, manager, Wichita Falls Electric Company, stated that this company had prepared the following rules for men engaged in electrical work:

Switchboard Instructions.

Safety First. Remember your family and protect your fellow workmen.

When operating the switchboard always stand on the rubber mat.

When throwing the switches, use but one hand.

When necessary, use rubber gloves, hanging upon the board.

Keep the board well lighted. Have oil lanterns always ready.

In case of fire open your exciter switches first, then use sand.

Report the slightest signs of trouble on the board.

Keep instruments and wiring all clean.

Use danger card when circuit is off for repairs or trouble.

Report all trouble on station log.

Watch temperature of oil in constant current regulator.

When working on back of board use wooden stool and rubber gloves.

Lineman Instructions.

Safety First. Remember your family, and protect your fellow workmen.

Learn the position of all circuits and wires upon the poles.

Use your rubber gloves in handling all wires. They may be alive.

Take the safest position on the pole.

Keep yourself free from grounds. Watch out for telephone cables and messenger wires.

In coming down a pole, watch out for street signs fastened to the pole.

In using tools on a pole, keep the groundmen away from the pole.

In making wire connections, use but one hand at a time. Don't get in circuit.

Constantly inspect lines for trouble. Keep all primaries clear.

Put away all tools at the end of the shift.

Keep your spurs, body belt and all tools in good condition.

Among the Contractors.

The Riverside Electric Company, of Jacksonville, Fla., has recently been awarded a number of important contracts, among which are the following: Three-story department store building, public theater, Jacksonville; Bradford County Bank, at Stark, Fla., and Bank of Fort Pierce, at Fort Pierce, Fla.

The Richardson Electric Company, Duluth, Minn., will re-wire three large grain elevators at Superior, Wis. The new wiring will all be done in conduit.

Sterling Electric Company, Minneapolis, Minn., has been awarded the contract for wiring, fixtures, lamps and shades in the Grand School, Minneapolis, Minn. The company also has a similar contract for wiring the Bremer School in that city. This will be a conduit job throughout and the company will furnish the fixtures, lamps and shades. A store building at 923-925 Nicollet Avenue will also be wired by this firm. Among the other recent contracts for electrical work in Minneapolis obtained by this company is one for wiring a four-family flat building at 2541-2543 Chicago Avenue, and one for the wiring of the residence of J. H. Pruber, 2628 Portland Street.

G. G. Burkholder Electric Company, Kansas City, Mo., has recently secured the contracts for wiring the Muehlbach Hotel and the Swinney School which are now in course of construction.

An important contract has just been closed with the Erner & Hopkins Company, Columbus, O., by the Ohio Fuel Supply Company. It calls for all the electrical work in connection with a new compressing plant at Fort Worth, Tex. A force of Erner & Hopkins men are now on their way to Fort Worth, to begin installation. It will take about four months to complete the contract. The Ohio Fuel Supply Company, whose headquarters are in Columbus, are just opening up a new oil and gas field in Texas, and the compressing plant is to be of the most modern type. A few years ago the Erner & Hopkins Company equipped a sugar plant at Brownsville, Tex.

Horton & Williams, Gary, Ind., has the contract for wiring the new Gary ice plant.

The Capital Electric Company, of Salt Lake City, Utah, has recently closed a contract with the Newhouse Hotel Company for the installation of a 75-horsepower three-sweeper Spencer turbine cleaner plant for the Newhouse Hotel now nearing completion at Salt Lake City.

The Ryan Electrical Company, Columbus, O., has received the contract for wiring and lighting the new annex building of the Central Building & Loan Company, of that city.

Electrical work on a unique building enterprise at Columbus, O., has been let to the Avery-Loeb Electric Company, of that city. The state is erecting on the grounds of the school for the deaf an office building for the Ohio Board of Administration. This body controls all of the penal and charitable institutions of the state, 22 in number.

The new hotel in Galesburg, Ill., will be wired by the H. Trask Electric Company, Galesburg. The circuits will all be carried in conduit.

The J. W. Turner Improvement Company, of Des Moines, Ia., has been awarded the contract by the Indiana & Michigan Electric Company for the installation of about 125,000 feet of conduit in the city of South Bend, Ind., together with about 200 ornamental lamp standards and 66 manholes. The Turner firm also has received a contract for installing considerable conduit in the city of Des Moines.

C. N. Rierdwan, Portland, Ore., has the contract for wiring the new Ice Hippodrome, Portland.

Harvey J. Doyle has recently entered the electrical contracting business, his place of business being located at 125 East Forty-third Street, Chicago, Ill.

The Seifferts Electrical Company has been given the contract for rewiring the Hotel Kingdon at Henderson, Ky. Metal conduits will be used throughout, and all the service wires will enter the building at one point, where as the old system was supplied by wires entering the building at seven different places.

Crescent Electric Works, Portland, Ore., will install the electrical equipment of the new National Theater in Portland.

The $9,000 contract for wiring the new male High School now being erected at Louisville, Ky., by Bailey & Koerner, general contractors, at a cost of $250,000, has been secured by the Neal Electric Company, of Louisville, a new concern. The contract provides for wiring only, the fixtures to be provided for later. Wires will be installed for lighting, clock, telephone, vacuum cleaner and bell systems.

The Star Electric Company, Portland, Ore., was awarded the contract for the installation of the city's new fire-alarm system.

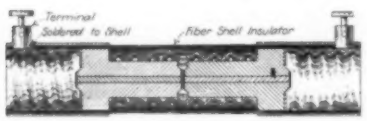
The Capital Electric Company, 311 East Monroe Street, Springfield, O., has recently been organized and will conduct an electrical contracting business.

Dollar Wiring Kinks.

Every reader is invited to contribute to this column. It does not matter how few words are used to explain a "Dollar Wiring Kink," provided the idea is made clear; and if a diagram is necessary, a rough pencil drawing will serve. The idea itself must, of course, be new and bright. A dollar will be sent to the contributor upon publication.

Wireman's Test Plug.

A very handy wireman's test plug is shown in one of the illustrations on this page. The plug consists of two adapters held together by a fiber shell in such a way as to permit the center terminals to make good contact. To the conducting shell of each adapter, a terminal is fastened thus permitting a length of conductors to be attached. This test plug is used for tesing motor and light circuits, switchboard and panelboard circuits and for fuse tests. Two 110-volt lamps are screwed into



Wireman's Test Plug.

the sockets when testing 220-volt circuits, and a fuse plug and a 110-volt lamp are inserted when testing 110-volt circuits.

M. J. Moriarity.

Removing Floor Boards.

In the July 11, 1914, issue of ELECTRICAL REVIEW AND WESTERN ELECTRICIAN there is an article by William A. Murray entitled "Removing Floor Boards."

Mr. Murray suggests that where it is desired to remove but a short length of floor boarding, two cuts, each at an angle of 45 degrees with the surface of the floor should be made across the board to form the opening for the pocket. Then when the piece that was removed is replaced the projecting ends that were cut at 45 degrees will support the piece.

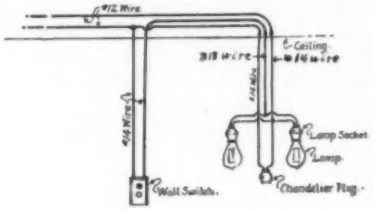
This is a quick, simple method of forming a pocket, but in the opinion of the writer it should be used only in cheap work or in locations such as attics or closets where the pocket will not be conspicuous. When the piece that was removed is replaced, it will drop down below the surface of the rest of the floor, possibly an eighth of an inch, because some of the wood was removed by the saw.

If it is desired to make a short pocket one end of the piece to be removed can be sawed at a right angle with the surface of the floor just at the joist. The other end can be cut at 45 degrees; then a cleat can be nailed on the joist to support and nail the square end and the projecting end of the board that remains in the floor will support the other end of the piece that was removed.

T. N. Markham.

Chandelier Attachment Plug.

Due to the increased use of electric cooking devices such as percolators, tea samovars, toasters, chafing dishes,



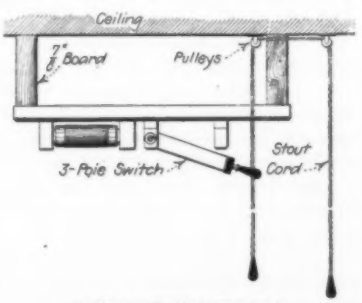
Circuits for Attachment Plug.

etc., need has arisen for a convenient means of operating these devices on the dining-room table from a chandelier without having to remove any of the lamp bulbs. At the same time it is desirable to have the heating devices supplied from a circuit of greater capacity than one of No. 18 wire. The illustration shows a good way of wiring a fixture for this purpose. The usual key sockets or wall switch may be used to control the lamps and a separate wall switch should be used as shown to control the heating device. A chandelier plug is used for attaching heating devices. This plug should be mounted at the body of the chandelier body.

Charles T. Phillips.

Controlling Ceiling Switches.

In the bottle-labeling room of a brewery it was desirable to have all wiring and switches installed on the ceiling so as to prevent damage to the



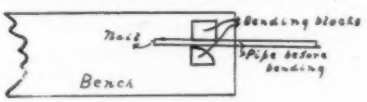
Ceiling—Switch Control.

electric installation and injury to operatives due to the damp conditions existing in the room. I therefore used the scheme shown in the accompanying diagram. The three-pole knife switches were mounted two inches from the ceiling as shown. To the handle of each switch a stout cord was attached and run over pulleys as shown. By simply pulling on the right cord the switch can be opened or closed.

M. J. Moriarity.

Making a Neat Conduit Job.

Sometime ago I had the job of putting in all the pipe leading out from a switchboard and as it was a public building we had to make a good looking job, so I adopted the following method which brought all the pipes the same height from the floor and the same distance apart. We took a ⅞ by 6-inch board that was as long as the switch board and bored 37 holes in it as that was the number of pipes we had, the holes, corresponding in size with the size of the pipe, were all bored the same distance apart. This board was built up about one foot above the finished floor line and then wired in place with strong iron wire. We then measured the height we wanted, the top of the pipe to come above this board and found it to be 20 inches. We drove a nail in our bending bench 20 inches from the edge and when putting a pipe in the blocks to bend it,



Bending Conduit.

we would butt the pipe up against the nail as shown in sketch. This made all the pipes the same height and as each man started a circuit he took one of these pipes, put it up through the hole in the board and worked from there. This board held the pipes in place when the concrete was run and was taken off when we were ready to pull in the wires.

E. W. Dullea.

Bending Conduit.

In bending conduit it is always a difficult matter to restrict the bend to the exact place wanted on account of the conduit bending a slight distance beyond the bending block. I have found, however, that by slipping a piece of conduit a size or two larger than that to be bent onto the pipe and sliding it up against the bending device a good smooth bend can be made.

C. B. Hutchison.

Straightening Fiber.

Sheet fiber which is now used extensively in electrical work often buckles when in storage. A good method to take out the kinks is to pass the fiber quickly through a flame such as that of a blow torch.

Ben R. Browne.

Public Service Commissions

Conducted by William J. Norton

IDAHO.

Southern Idaho Power Companies. The Commission has commenced a hearing in Twin Falls for the purpose of considering the fight which is now being waged for the control of the Southern Idaho power territory. The Idaho Power & Light Company and the Clear Lake Power Company are seeking to enter this territory in competition with the Great Shoshone & Twin Falls Water Power Company.

ILLINOIS.

Conference Ruling. The Commission has issued an order, July 13, regarding rates, rules and classifications for telephone service in the state. A number of rulings are given defining discriminations and determining proper classifications, terms and conditions to be established. Among the matters considered are: Free toll service, telephones in railway stations, classification into business and residence subscribers, prompt-payment discounts, temporary-service rates, charge for moving telephone, and charge for special wiring and equipment.

The Commission holds that all free and reduced-rate service is prohibited, including all free and reduced-rate service now given to public offices and officers of municipalities, "but it will not be the general policy of the Commission, on its own initiative, to inquire into the reasonableness of the terms and conditions of ordinances providing for compensation to municipalities in the way of telephone service, where the terms have been agreed upon between the municipalities of the state and the public utilities, prior to the taking effect of the Act creating this Commission." Where special rates have been in effect under individual contracts, the rates are to be changed to conform to the regular schedule of rates.

All telephone companies doing business within the state are ordered to change their rates, rules, and classifications not at present in harmony with this ruling, and two months is considered an adequate period of time within which to comply with the provisions of the order.

The Central Illinois Public Service Company was authorized to change the rates for residence electric-lighting service in Tuscola, abandoning the old rate, 15 cents per kilowatt-hour for all current used, and putting in effect the following rates: 14.5 cents per kilowatt-hour for the first 30 hours' use of the customer's maximum demand, or its equivalent, per month, and 8 cents per kilowatt-hour for all excess use per month.

The company is also authorized to make slight changes in minimum charge and prompt-payment discount provisions in its schedule for Sheldon.

Southern Illinois Light & Power Company. A complaint was made that the company's rates charged for electric service in Hillsboro are exorbitant. A hearing was held and subsequently the parties came to an agreement as to a schedule of rates and submitted a new schedule to the Commission for approval. The Commission points out that the new rates provide for a lower rate for the first block of energy for residence and commercial use than that previously charged and that an entirely new rate is provided for heating and appliances on a separate meter. The rates were approved by the Commission. For residence and commercial lighting the maximum rate is 12.5 cents per kilowatt-hour, for heating and appliances the rate on special meter, 4 cents per kilowatt-hour, and for power, 6 cents per kilowatt-hour.

INDIANA.

The Indiana & Michigan Electric Company, one of the largest public utilities in the state, has accepted an indeterminate permit from the Commission and surrendered its franchises in South Bend, Mishawaka and Elkhart.

The Commission's power to regulate utilities is not dependent upon their acceptance of the indeterminate permit. In an address before the Indiana Electric Light Association, Judge J. L. Clark, member of the Commission, has pointed out the advantages of the indeterminate permit as to the safety of investment, the ease with which the right to develop and extend the plant and system may be secured and the protection from competition. Protection from competition of a municipal plant can only be secured under the Indiana law to those utilities operating under an indeterminate permit.

The Commission authorized the company to issue an additional $150,000 to pay for recent improvements and extensions, the amount to be added to the $3,500,000 capital of the company.

MISSOURI.

The Springfield Gas & Electric Company. The Commission has dismissed the application for a rehearing of the order fixing rates of the Springfield Gas & Electric Company, rendered June 23, 1914. (ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, July 11, 1914.) No further majority opinion was filed in the matter, but Commissioner Wm. F. Woerner rendered a dissenting opinion on rehearing in which he says: "On reconsideration of this case I entertain grave doubt whether, all things considered, we have allowed the defendant electric company a sufficient valuation and an adequate return, and I dissent from the order overruling the motion for a rehearing."

NEW YORK.

The Rockland Light & Power Company was authorized to issue $463,000 of capital stock, the proceeds of which will be used to purchase the Rockland Electric Company, and certain outstanding notes of the latter concern, as well as to cover certain unfunded debts of the former company. In addition the Rockland Light & Power Company was authoried to acquire controlling stock in the Rockford Electric Company of New Jersey. The consolidation in addition to providing a more firm financial basis for the corporations concerned will also result in large savings in operating expenses and will have an important effect in the improvement and extension of gas and electric service in and along the west shore of the lower Hudson and in towns in northern New Jersey.

The Salmon River Power Company was authorized to issue $300,000 of five-per-cent, 40-year, first-mortgage bonds, to be sold at not less than 85. This sum is to be used for the discharge of obligations arising out of the construction of the company's hydroelectric plant and transmission lines, not provided for by the issues of bonds heretofore authorized, and to continue the work of construction on this plant. This makes a total bond issue for this project of $3,535,000.

OHIO.

The Anglaize Power Company was authorized to issue six-per-cent, noncumulative, preferred capital stock of the total par value of $666,600 and six-per-cent, five-year, collateral trust notes of the total principal sum of $200,000. The stock is to be issued in lieu of outstanding common capital stock and for the purpose of securing the surrender of the present outstanding first mortgage. The proceeds of the notes are to be used in discharge of accounts payable, certain judgments against applicant and floating indebtedness, and for the purchase of additional flowage lands and certain additions and extensions to its plant and system.

WISCONSIN.

The Cascade Telephone Company was authoried, in an order issued August 5, to increase its rates for telephone service and to put in effect a prompt-payment rule.

The East Valley Telephone Company applied to the Commission for a certificate of necessity and convenience to build an extension to the present system of the company in the towns of Scott and Sherman. The Random Lake Telephone Company objected to the proposed extension on the ground that the line was within its territory.

The Commission found upon investigation that the line had already been built in violation of the statutes. It points out, however, that this was only a technical violation as the telephone utilities in general were in ignorance of the intent of the law at the time the line was built. It was found that several subscribers on this line desired Random Lake Telephone Company service and the Commission states that a physical connection is the proper manner of meeting such service requirements. The decision was rendered July 31.

Vehicle Garaging in London.

The use of private electric passenger automobiles in England is exceedingly limited, but there is a considerable number of electrics of the taxicab type, particularly in London, which are kept for hire. The common practice among automobile owners is to use the petrol or gasoline car for touring the country and to depend on the public taxicabs for transportation within the metropolis. The congested character of the traffic in most London streets and the vast number of public automobiles everywhere at hand for hire, cause the owners of passenger cars to refrain from risking them in the congested streets to any great extent. This accounts for the remarkable dearth of private automobiles in the city streets.

The motor-car owners who have country places generally keep their vehicles garaged there, and when making visits to London by motor leave them in garages at the edge of town and employ taxicabs for trips into and about the city.

To meet this town demand there are several electric passenger-car garaging and letting concerns, besides those which provide gasoline cars in a like manner. Chief among the electric-car companies are the Hertford Street Motor Car Company (formerly the Electromobile Company), and the Krieger Electric Carriage Syndicate. Both do garaging and charging for a few private owners, but their business consists chiefly in letting out vehicles, with drivers, for the trip or by the day, week or month.

The Hertford Street Company's premises are centrally located in the West End. The Company has about 300 cars, mostly of the prevailing taxicab type of body, convertible, and accommodating two or four persons inside, the driver's seat being under a hood outside.

In some cases a car may be obtained here for service by a regular patron, and his coachman or chauffeur operate it, but generally the Company's driver accompanies the vehicle on all trips, which are engaged for by telephone, on instant notice if required.

The vehicles, which are of substantial construction and valued at about $3,000 each, are kept in an ample garage, with pleasant office and lobby at the front. In the center of the entrance area of the garage are three elevators which operate between this floor and the basement. When a car comes in from a trip, it is run over the elevator well and the elevator on which stands a truck on a section of track, is raised to the battery box, which is suspended beneath the car; two bolts are unscrewed and the battery, thus freed, is lowered to the basement, where a line of track extends in both directions the length of the room, and from it tracks run in parallel lines to the walls on either side. There is track room for 400 batteries each on its respective truck. The batteries are of the lead type, consist of 45 cells, and weigh 1,100 pounds.

At one end of the basement is the Company's private substation with five motor-generators installed, capable of providing 4,000 amperes. Current comes in from the Central station at 400 volts and the charging is done on 110 volts pressure. Leads from the generators are carried along the ceiling of the basement to the battery-truck area, where the charging is done. Meters are installed in front of each track, on the beam above. As soon as a battery is removed from a vehicle, a charged battery is sent up on the elevator and attached to the car. The process of replacing a charged battery for a spent one can be accomplished in as short a time as two minutes.

Batteries are assembled and old ones furnished with fresh plates in the battery room in the basement. The advantages gained from the uniformity in the construction of both the cars and of the batteries are obvious, in that the units are entirely interchangeable throughout.

For the few "foreign" or outside cars, charging facilities are provided on the ground floor for three cars at a time.

The headquarters of the Kreiger Company are near the Victoria Station, in Westminster, readily accessible to a fashionable residential neighborhood. The company's vehicles number about 60, for hire, and a half-dozen more are garaged for private owners. The cars are of the landau or landaulet type, of a very "smart" pattern, and the drivers seat is without a hood, thus differing from other electric cabs and gasoline taxicabs. They are mainly of French manufacture and have large back wheels, which add to their comfort.

The batteries are of 46 lead cells, and are divided, half being located under the front seat and half in a box under the rear of the car.

The company's charging equipment consists of two 50-kilowatt motor-generators receiving current at 400 volts and charging on 120 volts pressure, with the batteries remaining in the cars.

The company has a machine shop with motor-driven lathe, and does its own repairing and painting.

The general outlook for the electric-vehicle industry in England is generally recognized to be more expansive, perhaps, for the commercial vehicle than for the pleasure or passenger car. One obstacle to the increase in privately owned pleasure cars is the multiplicity of central stations in London, with differing equipment. There are in London some 50 private and municipal generating organizations. The Electric Vehicle Committee of the Incorporated Municipal Electric Association is working for uniformity in rates and charging facilities, and already about 60 central stations in England have agreed to a rate of one penny (two cents) per kilowatt-hour for off-peak charging.

The usual rate for charging during the peak hours of 6 to 9 p. m. is 2.5 and 3 pence per kilowatt-hour.

Utility Valuation Lowered.

The case of the Twin State Gas and Electic Company, of Dover, N. H., and that city for an abatement of taxes from the valuation of one million dollars, at which the company's property was assessed, has been settled by placing the value of the property taxable in Dover at $625,000.

South American Central Station Adopts Day Service.

The Venezuela Electric Light Company, Ltd., an English corporation which has no competition in supplying electric current for lighting in Caracas, Venezuela—both urban and suburban—installed daytime service on July 1.

It is unlikely that the sale of electrical fans, cooking stoves, irons, etc., will proceed rapidly until the people get accustomed to the innovation, and this probable delay will enable electrical supply houses in this country to get in touch with retailers there.

The electric light company has attempted to control the sale of all electrical fittings and has announced a policy of refusing to supply current unless its own agents make installations, the last-named requirement being on the theory that promiscuous wiring is decidedly dangerous and cannot be countenanced. However, the company has no authorized monopoly and it is recommended that American dealers get in touch with the situation.

Names of business houses in Caracas handling electrical supplies may be obtained from the Bureau of Foreign and Domestic Commerce at Washington.

PLANT OF THE GARFIELD ARTIFICIAL ICE COMPANY.

A New and Complete Electrical Installation.

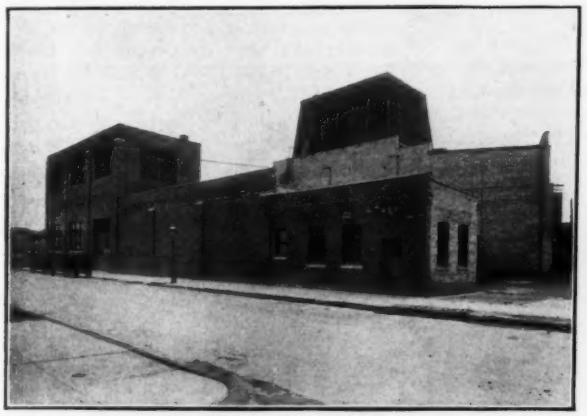
The very favorable rates offered by the Commonwealth Edison Company, of Chicago, Ill., to attract a permanent ice plant load to its lines, have enabled a number of plants to locate advantageously in new residential centers of distribution. At the same time the lack of smoke and noise has removed the objections of other property holders, which were so strongly raised against the steam-driven plant. One of the most recent and complete of these neighborhood plants is that owned by the Garfield Artificial Ice Company and located at 310 Turner Avenue, Chicago.

This installation, with a capacity of about 130 tons of ice per day, supplies its product to territory within a radius of two miles. Raw water only is used, and electric drive is installed throughout, the connected load in motors being approximately 400 horsepower. Power comes to the plant through the 4,000-volt, 3-phase lines of the Edison Company and is stepped down to 220 volts through a set of three 100-kilowatt transformers. The transformer bank is so located as to be easily reached from the roof of the plant.

The main switchboard, through which current is distributed both to the power and lighting circuits, is made up of three black slate panels. It carries in addition to the necessary switches and circuit breakers, a Minerallac contact-making clock, Printometer, Bristol recorder and Fort Wayne watt-hour meter.

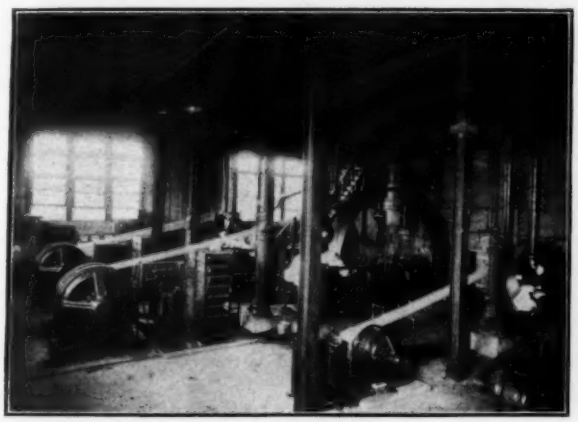
The notable feature of the installation is that practically all apparatus is installed in duplicate, thus substantially eliminating any chance of breakdown. Refrigeration for ice making is supplied by two Linde ice machines, each having a capacity of 60 tons of ice per day, and each driven by a 150-horsepower, 220-volt 60-cycle, slip-ring induction motor.

A third compressor with a capacity of 20 tons of refrigeration, is not installed in duplicate, as it is used only for pumping out the system and for supplying cooling to the storage rooms. This latter service can also be given by either of the large compressors.

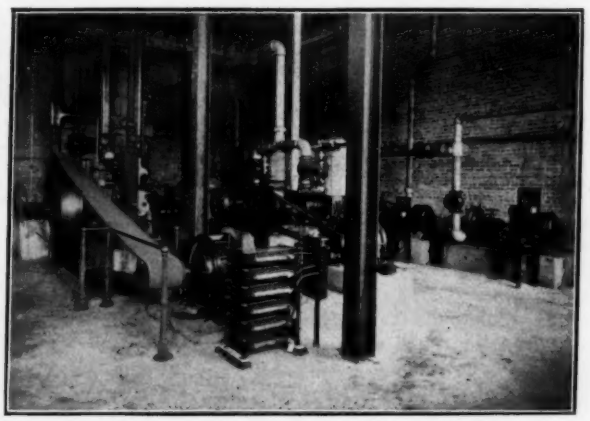


Garfield Artificial Ice Company.

Tank Room, Motor-Driven Pump in Center.



Motor-Driven Compressors.



Motor-Driven Auxiliaries.

Two smaller motors drive the blowers, which furnish air for agitating cores. Each set of this duplicate equipment consists of a 15-horsepower squirrel-cage motor belted to a Connersville blower of 2.5 cubic feet displacement. The air from the blower is thoroughly washed in an air tank, carried through a drier, and taken dry and clean to the tank room.

Two 10-horsepower motors, each direct-connected to a centrifugal pump, complete the electrical equipment of the compressor room. These pumps are designed to deliver 600 gallons per minute each, against a 42-foot head. Only one at a time is used, this circulating the cooling water through the condenser and cooling tower located on the roof of the plant.

Incoming water from the city mains is thoroughly filtered by three quartz filters on the floor of the compressor room, before going to the fore-cooler, which is also on the roof. Coming to the filters at a temperature of 74 degrees during the summer, the water is brought down in the fore-cooler to a temperature of about 38 degrees.

While refrigeration of the fore-cooler and the storage rooms is accomplished by direct expansion, a Wolf accumulator is provided for each of the large compressors. In this device the suction gas coming from the refrigerating coils passes through a tank containing liquid ammonia, thus precooling the ammonia before it passes to the liquid header of the ice tank. The accumulator also acts as a trap to catch particles of liquid taken along by the suction gas, and particles of oil brought from the compressor.

Adjoining the compressor room is a small space containing a 15-horsepower motor driving the brine agitators. Here is also a two-horsepower motor direct-connected to a centrifugal sump pump. All water from the sump goes to replace the small evaporation losses in the cooling system.

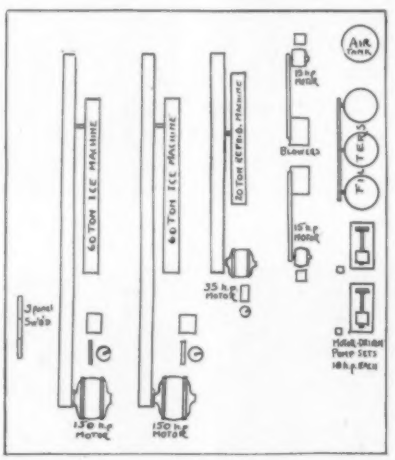
In the tank room are 1,200 400-pound cans filled with cooled and filtered water and frozen on a 44-hour basis. From the time a can is set in place the water is agitated with a current of washed air to separate impurities. At the end of 24 hours the first core is sucked. Power for this is provided by a two-horsepower motor belted to a Gould No. 4 centrifugal pump. A second sucking is given six hours later. The core water in both cases is delivered to the pans of the cooling tower, and goes to replace evaporation loss of the system.

Other electrical equipment of the tank room consists of two traveling cranes used to lift cans of ice from the brine and carry it to the dipping tanks.

To provide for excess demand or unforeseen shutdown, three large storage rooms with a total capacity of 5,000 tons of ice have been provided. There is an additional today's storage room, with a capacity of 600 tons. Ice is elevated from the today's storage room to the larger rooms by a set of three hoists, all driven by a five-horsepower motor located on the roof of the plant.

The plant is at present using about 250 kilowatts, keeping this power consumption practically steady through the whole 24 hours, thus entitling it to a rate of one cent per kilowatt-hour. The conditions necessary for an installation to secure this rate are that power is used only for refrigeration, ice making and ice-cream making, and that the maximum demand during June, July, August and September shall not fall below 200 kilowatts, or the load-factor at any time below 65 per cent.

Approximately 4,000 gallons of water are used daily at this plant. Practically all of this is consumed in ice, air washing and cores, the evaporation loss from the cooling system being made up from the sump water and core water. Cost for water amounts to about two cents per ton of ice, and cost for power in the vicinity of 48 cents.



General Layout of Compressor Room.

Electrolytic Disinfectant is a Success.

Dr. Alexander, medical officer of health of the borough of Poplar, London, England, reports continued success of his electrolytic disinfecting fluid for supply to sick asylums, public baths, schools and the general public. This was described in our issue of April 12, 1913. The past year's output has been 66,740 gallons as compared with 54,388 in the previous year. Electricity consumed cost approximately $355—11,367 kilowatt-hours at close to three cents per kilowatt-hour. There were used 5.025 tons of chloride of magnesium, 10 tons of salt, and caustic soda and water, the total cost of materials including electricity being $636. The electric motor (for stirring) used 310 kilowatt-hours.

An unlimited supply of the fluid is given to the public baths and other institutions named; the taxpaying public bring their own receptacles to the depots. Four London schools, where the class-room floors were sprayed and cleansed, accounted for 1,094 gallons, and 18,175 gallons were employed in three public baths for keeping the water fresh and free from harmful organisms. Poplar swimming ponds are not always used by people free from infection or clean. At Poplar the electrolytic fluid costs a little less than one cent per gallon. Thirty gallons are added to the swimming pond of 85,000 gallons capacity on first filling, and subsequent additions are made as required each two or three days.

Dr. Alexander claims that the process has been a success for eight years, notwithstanding adverse criticism. Plants are already used by the British War Office and Admiralty and others have quite recently been sent to Finland, Buenos Aires, and Rangoon. A plant has been ordered by the Gateshead municipality, and a large one is now being installed by Portsmouth corporation. In this last case the fluid to be electrolyzed is seawater so that there is no cost for materials.

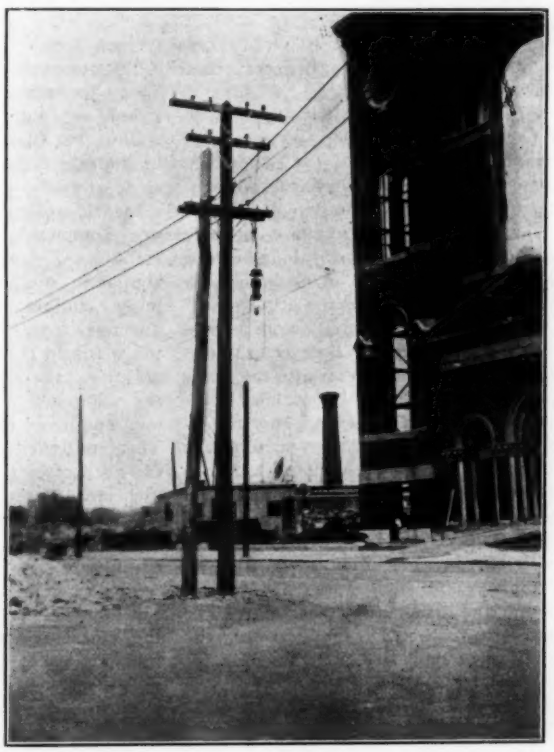
Many improvements have been made since the first plant was installed at Poplar. Recently an important improvement relates to the reception of the fluid from the electrolyzers. Instead of glass receptacles which are apt to break and are costly, specially made but cheap metal drums have been substituted. A double cell has just been constructed of slate in such a form that creeping of the current from one cell to another is prevented. "This," says Dr. Alexander, "is a most important item. All slate contains metal, and the current in creeping from the electrodes in one cell to the electrodes in the other cell, causes erosion to take place, and sooner or later a 'dead short' happens, and a new double cell is required, which is an expense." The present cells are earthenware. Electricity, on account of moisture, will even creep with an earthenware cell and efficiency will be lost, and if the partition of the earthenware cell or tank is not properly glazed it will in course of time become destroyed by the electric current (240 volts and 20 amperes) acting upon the fluid, which soaks into the unglazed earthenware. Earthenware cells take a long time to make (four months), and then are likely to have defects.

Rehabilitating Salem's Electric Service.

With the gradual rebuilding of the factories which were destroyed in the conflagration that swept through the heart of Salem, Mass., on June 25-26, the Salem Electric Lighting Company is slowly regaining its normal power load, while the lighting of the streets of the burned area is being accomplished by means of a temporary installation of arc and incandescent lamps.

The admirable promptness with which the company rallied to the relief of the citizens, and the gratifying manner in which the power station withstood the surrounding flames, owing to its fireproof construction, were pointed out editorially in our issue of July 4. The conditions under which the fire occurred, and the mode of providing for the emergency thrust upon the plant, will be of interest.

Salem Power Station Unharmed by Fire which Destroyed All Surrounding Buildings.



Temporary Street-Lighting Installation in Burned District.

At the moment when the fire occurred the company was about to underground its wires throughout the larger part of the city. Some two years ago 3-inch fiber conduits, laid in cement, had been placed throughout the closely settled portions of the city, both east and west of the Boston & Maine Railroad tunnel, which penetrates the center of the business district. Owing to plans for station improvements and the double-tracking of the antediluvian single-track tunnel, the installation of the wires in the conduit had been postponed until the present summer, when, despite the fact that railroad improvements had not been made, it was decided to underground the wires.

The cables had been secured and were on the ground ready to be installed beginning on the Monday following the Thursday on which the fire occurred. Of the 40 or 50 reels of cable, all but two were destroyed in the conflagration.

The fire began its work of havoc at about noon June 25 at a most inopportune time for the lighting company, most of the employees being away on a field day. The men in charge of the plant worked heroically, and those on the outing returned at top speed on learning of the outbreak of fire. Attention was naturally divided between the company's property and the homes of the employees, a number of whom, including S. Fred Smith, the manager, lost both their homes and much of their belongings. Mr. Smith, on reaching the station, at once took charge and succeeded in rescuing from the office the funds and the principal working books. In this labor he was greatly assisted by Warren D. King, manager of the municipal plant of the adjoining town of Peabody, who conveyed the valuables to his own office and placed them in safe keeping.

The progress of the fire, driven by a strong west wind, swept everything before it. On one side of the station, across a narrow street, a line of wooden tenement houses were burned, the fire presenting a wall of flame against the very side of the brick structure of the company. The admirable construction of the station, with walls one foot in thickness, wire glass windows and tile roof, successfully resisted the blazing mass of sparks and combustible materials that beat against it. The office building and storehouses which occupied a position some hundred feet in front of the station, succumbed and were completely wiped out.

Four employees of the generating plant were held prisoners in the station while the conflagration swept around it. The engines had to be shut down owing to the damages to street circuits, but neither machinery nor building suffered except for the breaking of the glass windows and trifling damage to the tiles of the roof.

All the circuits leading from the station, however, were destroyed, for a distance of several hundred feet, the poles being burned and the wires broken. Among the outgoing lines was a 500-kilowatt auxiliary to the Bay State Street Railway Company.

The manner in which the grave situation was relieved was exceedingly gratifying to the citizens. At once the extent of the damage was learned, the managers of the Malden and the Revere central stations, which, togeth-

er with the Salem Company, are under the management of Charles H. Tenney & Company—personally came in haste to Salem, bringing gangs of men with them. With the employees of F. T. Ley Company, who were working on construction at the time, the process of erecting poles was begun the morning of June 26, 150 men in all being employed. At the time the debris was scarcely out of the streets and the ground was still hot. Meanwhile the services of the Peabody plant, which habitually maintains reciprocal emergency service with the Salem company's plant, were tied in and utilized to supply a district bordering on that town.

The poles held in reserve having been burned, 100 poles were secured from the Lynn Gas & Electric Company and a further supply from other neighboring companies.

At 11 o'clock the night of June 26 a part of the destroyed services was reinstated, and none of the company's customers was without electrical connection for more than two days.

For days a number of the company's employees were busy salvaging burned wires, which, divested of insulation, are being disposed of by the ton.

The street lights were out of operation only one night. To meet the immediate and urgent necessity, the manager procured from the Malden company a spare stock of 6.6-ampere series inclosed alternating-current arc lamps. Forty of these units, together with 123 60-candlepower incandescents, have been installed in a temporary fashion, the arcs being suspended by cords from poles of the lighting company and also those of the telephone and street railway services. The necessity of the case required only the lighting of such streets as are used for through traffic, the burned residence side streets thus far needing no night illumination.

The difficulties of making the first steps in rehabilitating the electric service were enhanced by the complications introduced through the city being under military rule for a time. Conflicting orders as to rights and privileges in the streets greatly hampered the work. The streets being filled with sightseers made the linemen's labors more involved.

The temporary character of the present installation in the burned district is kept in statu quo owing to the projected changes in street lines under consideration by the commission of five men who are in charge of the rebuilding of the city.

Most of the important industrial plants of Salem were swept away in the great fire. The Naumkeag Cotton Mills, which were equipped throughout with motors aggregating 1,200 horsepower, a stone crushing plant using about 750 horsepower, and other establishments making up a load of some 3,000 horsepower in all, were burned. Nearly all the factories are to be rebuilt, and some of them are already undergoing construction. The present week the Naumkeag company is taking 100 horsepower or more to drive machinery already installed, and other factories will soon follow.

The destruction of the lighting company's office building and supply department necessitated the establishing of an office uptown, this being located at 72 Washington Street. Extensive buildings will be erected in a few months on the site of the burned structures, but the offices will continue to be maintained on one of the uptown streets.

Temporary structures were put up to house the supply department, and for storehouses, directly in front of the station, but these will soon be replaced by more substantial buildings on the same grounds.

Mention should be made of the Tenney Company's thoughtfulness for its employees. Assistance was given in abundant measure by the loan of money and in other substantial ways, one man from the head office in Boston being in charge of the relief work.

During the days following the fire the company housed and fed the 150 men employed on reconstruction work. This continued for three weeks, until the need of help outside the company's own men ceased.

The Peabody plant furnished current in gradually diminishing quantities until July 10.

This plant lost its generating station through fire on August 8, 1913, and the emergency thus created was met through the aid of the Salem company's service.

The manager of the Salem Electric Lighting Company expresses his deep appreciation of the co-operation freely bestowed by the electrical fraternity in New England. While the fire is a severe blow to the historic city of the witches, the citizens are zealous in their efforts to rebuild the waste places on lines more attractive and at the same time more enduring than the structures that were swept away, and the aid of the lighting company is being directed to further that end.

New Plant at Morganfield.

Adequate electrical service is assured to the people of Morganfield, Ky., by the recently completed plant of the Morganfield Light & Power Company, of which F. W. Gilbert is manager and principal stockholder. Robert Pride is assistant manager. The plant, which is sheltered in a new, 50 by 90-foot brick building, replaces the old plant of the company which the needs of the city had outgrown.

Duplicate sets of engines, boilers, furnaces, and generators, insure the patrons of the company uninterrupted service. The boilers, each of 200 horsepower of the Scotch marine type, are heated by Burke smokeless furnaces, which communicate with a 75-foot concrete stack. To the engines, one of 225 horsepower and the other 125 horsepower, are belted General Electric Company generators, of 150 and 75 kilowatts capacity, respectively. Water, drawn from a deep well by motor pumps, is heated to 206 degrees before it is turned into the boilers.

Tennis Courts to be Electrically Lighted.

Tennis enthusiasts, of which there are many in Louisville, Ky., have been interested to hear that the Louisville Gas & Electric Company is contemplating demonstrating how electrically lighted tennis courts should be equipped at the courts on the company's own property at Seventh Street and Ormsby Avenue. There is a spirited tournament on at this time among the young men in the employ of the Louisville company and Robert Montgomery, manager of the company's commercial department, is seeking to persuade the officers of the company that equipping one of its own courts with electric lights would be a good investment.

Interest in Louisvile in the proposition has increased considerably since it has been learned that in Lexington, Ky., one of the courts at the Lexington Country Club has been equipped with a lighting system for night tennis, and since then the night playing has proved most popular in the "Bluegrass Capital."

City Contract at Urbana.

A long controversy between the Urbana Light Company and the city of Urbana, O., over street lighting has been ended. A new contract has been signed under which the company will supply current to the city for ten years from August 1, furnishing 100 flaming arc lamps at the rate of $57.50 a year for each, and as many incandescent lamps as the city desires at $25 per lamp.

The company also agrees to remove or change the location of poles as the city desires.

Power House Fires.

On July 23 fire destroyed the plant of the Phillips Electric Light & Power Company at Phillips Woods, Me.

On July 24 the electric light plant at De Graff, O., was also destroyed.

THE COMPUTATION OF THE COST OF CURRENT.[1]

By Hugo Eisenmenger.

General Expression for the Cost of Current.

If one would attempt to obtain an exact expression for the cost which every consumer causes to the central station, one would arrive at a very complicated formula which, transferred into practice, would mean that every consumer would have to be granted a separate rate. This formula would have about the following form:

$$k = c_1 + f_1(e) + f_2(d_o C_o) + f_3[\psi(t), \psi_1(t), \psi_2(t) \ldots \psi_n(t)] + f_4(l) + \ldots\ldots\ldots\ldots\ldots (1)$$

where

k is the annual cost which the respective consumer causes to the central station.

c_1 is a constant which expresses the cost of billing and collecting, meter reading, etc.

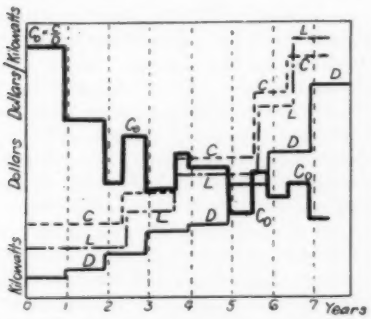


Fig. 1—Annual Demand D, Capacity L of the Central Station, Invested Capital C in Dollars and C_o in Dollars per Kilowatt.

e is the amount of energy annually consumed by the customer.

d_o is the maximum demand of the consumer at central-station peak load, in other words, the share of the consumer of the peak of the central station.

C_o is the capital invested in dollars in the generating, transmitting and distributing system per kilowatt of the peak load.

$\psi(t)$ is a function which represents the current demand of the respective consumer dependent on the time, in other words, the load curve.

$\psi_1(t), \psi_2(t) \ldots \psi_n(t)$ are the function $\psi(t)$ applied to all the other consumers.

l is the distance of the consumer's location from the central station.

As indicated by the series of points at the end of equation (1) the number of the different functions is far from being complete. Moreover the functions f_1, f_2, f_3..... cannot be determined exactly and the same is true of the constant c_1 since they depend on certain elements which cannot be expressed mathematically.

Thus it is evident, for instance, that the function $f_1(e)$, that is, that part of the cost which depends on the number of kilowatt-hours consumed, does not only become smaller for a given value of e if in the course of years larger and more economical machinery is used but the value of the function also depends on the time of the day during which the energy is demanded. If the consumer, for instance, demands his energy at such a time that the putting into operation of another set of engines, perhaps with a separate crew, becomes necessary it is evident that the cost per kilowatt-hour is much higher than if the electric energy is required at such hours that a certain number of generating sets are running just at full load. This variation might also be expressed by the function f_2. The losses in the conductors and transformers have also an influence on the function f_1, etc.

Also the capital C_o invested per kilowatt of maximum demand is subject to considerable variations as shown in Fig. 1. What is given originally is the annual maximum demand D of the central station which increases according to a staggered curve in the course of the operating years. The curve of the capacity L of the central station and the size of the generating set to be erected, respectively, is determined on the basis of this curve D. If a new generating set is erected it will generally always be ready some time before the annual maximum of the load comes on (curve L). The curve L in its turn determines the curve of the invested capital C. The capital, however, does not increase in exact proportion with the capacity of the engines especially since with the taking into operation of a new engine, frequently older engines are taken out of operation altogether. If now the capital per kilowatt capacity, that is, the ratio $C_o = C/D$ is calculated for different abscissae, as done in the heavily outlined curve C_o, the results will show that this term is not constant. It does not only change in the course of years but is subject to erratic and sudden variations during the year. Similar considerations will hold true for the capital invested in the transmission and distribution lines.

Also the term c_1 should be considered as a variable and not a constant if accuracy is desired. This term is a function of elements which cannot be expressed mathematically. It should express in substance the expenses that the consumer causes by the mere fact that he is a customer of the central station. It should therefore comprise the cost of meter reading and calibrating, accounting, billing, collecting, handling complaints, and also interest, maintenance and amortization of the meters, house service connections, etc. If the number of consumers increases, for example, just beyond that number for which the present number of bookkeeping employees is sufficient, a new employee must be added and his salary must be distributed over the cost of all consumers so that the amount c_1 increases suddenly but gradually decreases again as the number of consumers increases. The average value of c_1 as a function of the time will therefore be of the character of the curve shown in Fig. 2. The value of c_1 is, of course, different for different consumers. If, for example, the central station has meter consumers and flat-rate-demand consumers, c_1 will be smaller for the latter than the former since the flat-rate-demand consumers do not cause any expense for interest, amortization, repairs and reading of the meters, etc.

Simplification of the Theoretical Basis for the Requirements of Practice.

The expression for the rate for furnishing electric current must now be computed so that it considers the cost of such service as accurately as possible. However this expression must be as simple as possible in order to be understood by the consumer and in order to make possible a simple calculation of the

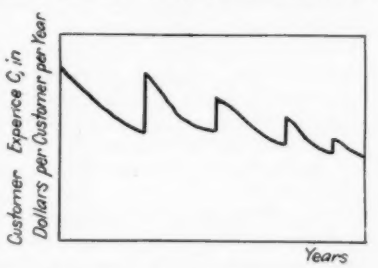


Fig. 2—Variation of Customer Expenses in the Course of Time.

current bills. These requirements for accuracy and for simple rates, are directly opposed to each other as has been explained before and the dilemma necessitates the drawing of a compromise, as accuracy has to be partly sacrificed in order to gain in simplicity. The measure in which this is done is different with different rates. In the case of almost all rates equation 1 is simplified in such a manner that not more than the first three terms are considered. These terms, however, are considered in such a way that the sum of the cost of all consumers which results from the simplified formula is not changed as compared to the actual total cost. One has, therefore, to distribute the average value of the neglected terms per consumer in some way over the first terms. Thus, for instance, the cost for those consumers which are situated close to the central station is increased in favor of those who are situated further away, etc. This will be treated more fully later.

Another approximation which is gen-

[1] An article along the same lines was first published by the author in the *Elektrotechnische Zeitschrift* for January 1, 1914.

erally made consists of the following: the values of the functions $f_1(e)$ and $f_2(d_0 C_0)$ are assumed first to be proportional to e or $d_0 C_0$, respectively, that is, they are replaced by the values $c_2 e$ and $c_2' d_0 C_0$ in which c_2 and c_2' are constants. Moreover, instead of the demand d_0 drawn by the customer at peak-load of the central station, which demand cannot be determined except with expensive recording instruments, the maximum demand d of the consumer is introduced, or sometimes in the further approximation his connected load is introduced. From these considerations one obtains the expression

$$k=c_1+c_2e+c_2'd_0C_0 \quad \ldots\ldots\ldots\ldots\ldots\ldots (1A)$$

Finally it is generally assumed that the capital invested per kilowatt C_0 is constant and equal for every consumer falling under this system of rates. This means that the curve $C_0=C/D$ of Fig. 1 is assumed to be a horizontal straight line. One then obtains the well known fundamental formula

$$k=c_1+c_2e+c_3d \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

This equation which represents the cost (and with an adequate enhancement for profit of the values c_1, c_2, c_3, also the rates) is presumably the most accurate approximation to the actual value of the cost which occurs in practice and is called the three-charge rate system.

The current bill of the consumer is then virtually composed of three parts although the latter must not always be explicitly expressed as so many parts of the bill and may be concealed in one way or another in the schedule. These three parts are:

(1).—A constant c_1 or consumer charge corresponding to the consumer cost in the computation of the total cost. This charge is sometimes made under the title of a meter rent or it is neglected for larger customers and replaced by a minimum charge for smaller customers. Frequently, however, it is expressed implicitly in the rate schedule as considered later.

(2).—An amount c_2e which is consequently an amount that is proportional to the number of kilowatt-hours consumed according to the meter reading during the period of time covered by the bill. The factor of proportionality c_2 is called the kilowatt-hour charge or energy charge, or kilowatt-hour cost. The kilowatt-hour cost must not be confused with the cost per kilowatt-hour, that is, with the ratio of total cost of power generated to total number of kilowatt-hours generated.

(3).—An amount c_3d proportional to the measured or estimated maximum demand or connected load. c_3 is called the demand charge to cover the demand cost. By leaving out one or two of these three charges, or, more exactly expressed, by distributing the respective amounts to the other charges, various other forms of rates result which are used in practice. If one lets, for instance, the demand charge c_3 equal zero in equation 2 a straight kilowatt-hour rate with a meter rent will result or the cost will be expressed in form of a rate[2] of that kind, namely,

$$k=c_1+c_2e$$

If one lets c_1 and c_2 equal zero in equation 2 one obtains the cost for a pure flat-demand rate $k=c_3d_3$, etc. If the special case in which one or two charges are equal to zero is included under the term three-charge system and in equation 2, as shall be done in the following discussion, the term three-charge rate system covers with very few exceptions also most of the rate systems which are apparently much more complicated as can be easily shown by analytic or geometric representation.[3]

Result of the Diminution of the Number of Charges.

A few words may be added here about the result of a reduction in the number of the charges. It has been mentioned that in practice, with a view to the simplicity of the rate, not more than the first three functions of equation 1 are used. The rest of the functions are distributed, as will be described later, in some way, among the consumers so that the average values of the functions are included in the three charges. It must not be overlooked, however, that every suppression of certain functions or charges of that kind will naturally aid in securing just those customers with whom the suppressed function causes higher expenses than the average. With existing consumers such suppression of function will create in them the tendency to adjust their consumption in such a manner that the function the average value of which is included in the rate charged in a way that appears as if it were given gratuitously, is used to a larger extent.[4]

Since the cost represented by these functions must be paid under any circumstances by the consumers those consumers who cause a smaller cost than the average for the respective function will have to pay more than they really ought to be charged and they will partly be kept away from the lines.[5]

If, for instance, the term c_3d is suppressed, which represents the demand charge, the costs which are caused by the maximum demand are distributed equally over all consumers in about the proportion of their kilowatt-hour consumption. A certain number of consumers with a very small load-factor at unfavorable diversity-factor will then be established and because of the small amount which they pay under their kilowatt-hour charge and consumer charge do not even cover their cost. This loss must be covered by the profitable consumers and contributes its share towards maintaining the kilowatt-hour charge on a generally higher level. Among thousands of profitable consumers several will always be found which are kept away from the line by this difference of price. Hence the profit of the central station is also kept lower, which in turn establishes a *circulus vitiosus*. If, for example, in the above mentioned example a demand charge should be introduced in some form, one of three things will happen with those loss-causing consumers. They will either remain off the line or they will improve their load-factor by reducing their maximum demand, or finally their current bill will increase to such an extent that they become profitable. The rates can then be kept lower, the number of consumers will increase, the central station will increase in size and consequently will produce current more economically, and the rates can be further lowered so that it may become possible that even the first mentioned consumers with low load-factor may gain by the introduction of the demand charge.[6] Whereas in this example by the omission of the demand charge the load-factor of the central station will deteriorate, it would conversely be improved by removing the kilowatt-

2 A pure meter block rate would also be represented under this case. For example a rate of 10 cents for the first 20 kilowatt-hours and 5 cents for all kilowatt-hours beyond the first 20 would mean for all customers using more than 20 kilowatt-hours an equivalent rate of $1.00 customer charge and five cents energy charge. (See also footnote 3.)

3 Further data by the same author have been published in the annual report for 1909-10-11 of the Rate-Research Committee of the National Electrical Light Association and in the *Electrical World* of November 4, 1911, in an article entitled, "Space Representation of Central-Station Rates." Other articles by the same author that should be referred to and compared, "Some Geometrical Aspects of the Three Charge Rate System" in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for February 11, 18, and 25, 1911, and particularly the article entitled "Graphic Representation of Electric Rates" in the *Journal of Electricity, Power and Gas* for July 21 and 27, 1912, which treats of the different methods by which the same rate system can be represented by different schedules that are entirely equivalent but externally absolutely different. Compare also the author's article entitled, "The Theoretical Justification of the Wright Demand-Rate System" in *Electrical World* for May 24, 1912. To quote a simple example from the latter article a "Wright demand-rate of 10 cents per kilowatt-hour for the first 30 monthly hours use and three cents per kilowatt-hour for all electric energy beyond this corresponds to a straight 10 cents-per-kilowatt-hour rate for all those consumers the load factor of whom is smaller than 30 hours per month and to a rate of 3 cents per kilowatt-hour with a demand charge of $2.10 per kilowatt per month for consumers of higher load factors.

4 In order to illustrate this by a drastic if trivial example, let us imagine a saloon with gratuitous lunches. The cost of the lunch is averaged into the price of the beer and it is doubtless that in a lunch counter of that kind more sandwiches will be consumed than if the customer would have to pay for sandwiches according to what he consumes with a corresponding reduction of the price of beer. A railway which does not make any charges for passenger baggage will find doubtlessly that the average weight of baggage per passenger is greater than if every passenger would have to pay for his baggage separately according to the weight he carries. In an apartment where hot water is included in the rent more hot water will be consumed than where the tenants have to pay for hot water as a separate item.

5 Thus in the example in the footnote 4 a railway which does not charge for baggage will for that reason have a tendency towards higher rates because the passengers will carry a larger amount of baggage the expenses for which will have to be paid by the passenger fares.

6 Compare also Edward T. W. Cowan's article entitled "The Price of Electricity" in *The Electrician*, London, England, for September 9, 1910.

hour charge by granting a flat-demand rate. This improvement, however, would be without direct profit to the central station since it would be brought about in such a manner that the consumers would be wasting energy for the simple reason that they do not have to pay for it and the demand charge would have to be high enough to include the cost of this waste, which would not occur under a complete three-charge system. Consequently, as before, the consumers which do not waste that element of electric load which is offered gratuitously must help pay for the waste of others.

In general, experience has shown that the introduction in one or the other way of all three fundamental charges mentioned is the most advantageous compromise between the contradictory requirements of accuracy and simplicity of the rates. It must be clearly understood, however, that there are *important exceptions* to this rule to be made for secondary reasons for special groups of consumers such as, for example, very small consumers where the straight flat-demand rate has brought about brilliant results in soliciting the business.

Determination of the Numerical Values of the Cost.

In order to make a correct and appropriate rate, one has first to know the numerical value of the cost of the three charges or two of them, according to how the rates shall be shaped for the respective central station. This is done by proper separation of the total cost.

In attempting to make a separation of that kind one perceives at once a number of expenses which belong apparently entirely to a single one of the charges. Thus, for instance, one will be inclined to charge the expenses for fuel entirely under the heading of the kilowatt-hour expenses and to charge on the other hand the capital expenses entirely to the demand charge. According to what has been said in the lrst portion of this article this is not correct since the suppressed functions of equation 1 will always assert themselves. Thus, for example, the expenses for fuel do not only depend on the number of kilowatt-hours generated or sold but also on the size and economy of the generating sets employed and, therefore, incidentally to a certain degree also on the maximum demand. The expenses will further depend on the shape of the load curve, on the purchasing price and the quality of the fuel, etc. Therefore, a certain part of the fuel cost will have to be ascribed to the demand charge whereas a third part cannot be ascribed to any of the three charges directly and completely and therefore not to the kilowatt-hour charge.

Other factors must be left entirely to crude estimation and rather arbitrary guess work which one of the three charges shall take care of it and to what extent. The capital expenses of the transmission and distribution lines may serve as an example. They depend not only on the maximum demand and on the energy in kilowatt-hours consumed by the line, but also on the number of consumers since the lines certainly would require a smaller capital if the total current would be consumed by one single consumer in the center of gravity of the territory of supply and if all the ramifications of the transmission and distribution system would become unnecessary. The capital expenses of the transmission and distribution system depend besides to a very large degree on the distance of the location of the consumers' premises from the central station. This factor of the geographical distribution of the customers which has been suppressed cannot be represented at all as a function of the number of consumers or of the demand or of the energy sold, except if certain additional assumptions are made. This leads to an uncertainty and arbitrariness in distributing the capital expenses of the lines. Such an additional assumption might be, for example, that the relative geographical distribution of the consumers' demand and energy over the territory of supply remains constant in spite of the growth of the number of customers, their demand, and their energy. This assumption, however, in most cases will not be justifiable since in general the territory of supply will increase in size and change in shape. A better assumption would be that the relative geographical distribution be changing in the same manner relative to the change of the three not suppressed factors as it has been changing during the last one or two or three years.

If such classifications are made, a synthetic method is usually employed by giving every division of the expenses as shown by the books of the company to one or to several of the charges on the basis of a rough estimation. After proper addition of the amounts shown under each separate charge, the total expenses are divided into three parts, of which the first one means the consumers' cost and has to be covered by the consumers' charge, the second one is to be covered by the kilowatt-hour charge and the third one by the demand charge. In order to arrive at the consumers' charge per customer one has therefore to divide the first part with a proper increase for profit by the number of consumers. The second part divided by the number of kilowatt-hours furnishes the kilowatt-hour cost per kilowatt-hour or with increase for profit the kilowatt-hour charge. In an analogous way the demand cost per kilowatt is found in the third part.

These arbitrary distributions are done away with if the analytic method is employed. The fundamental principles of this method have been briefly referred to by the author in his article "Some Geometric Aspects of the Three-Charge Rate System" in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for February 11, 18 and 25,, 1911, and will be described in detail in the following:

Analytical Method of Determining the Numerical Values of Cost.

An analytic method may be employed for determining the numerical value of cost. This method may be described as follows: Assume that in a certain year the number of consumers of a central station was N_1, the total kilowatt-hours generated was E_1, and the maximum demand of the power house was D_1. The total expenses for that year were K_1 dollars, including the interest of the bonds and stocks, the latter being taken at a certain fixed minimum percentage of dividend which may be either assumed equal to the bank percentage or to the percentage of the bonds.

Equation 2 reads as follows:

$$k=c_1+c_2e+c_3d \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Adding these equations for all consumers the following equation is obtained.

$$\Sigma(k)=c_1N+c_2\Sigma(e)+c_3\Sigma(d) \quad \ldots\ldots (2a)$$

If we let preliminarily the diversity factor $\Sigma(h)/H$ and the ratio kilowatt-hours sold/kilowatt-hours generated $= 1$, equation 2a will change into

$$K_1=c_1N_1+c_2E_1+c_3D_1\ldots\ldots$$

For the following year we find

$$K_2=c_1N_2+c_2E_2+c_3D_2\ldots\ldots \quad (3)$$

and for the third year

$$K_3=c_1N_3+c_2E_3+c_3D_3\ldots\ldots\ldots\ldots$$

In these equations the values of K, N, E and D are known and we have therefore three linear equations for determining the three unknowns c_1, c_2, c_3. These are:

$$c_1=R_1/R. \quad c_2=R_2/R. \quad c_3=R_3/R.$$

where R, R_1, R_2 and R_3 are the following determinants:

$$R=\begin{vmatrix}N_1E_1D_1\\N_2E_2D_2\\N_3E_3D_3\end{vmatrix} R_1=\begin{vmatrix}K_1E_1D_1\\K_2E_2D_2\\K_3E_3D_3\end{vmatrix} R_2=\begin{vmatrix}N_1K_1D_1\\N_2K_2D_2\\N_3K_3D_3\end{vmatrix} \text{ etc}$$

It is not necessary, of course, to employ determinants as indicated for the solution of these equations. On account of the small number of unknowns any elementary method, such as the method of substitution or of elimination, will serve as well.

A graphical representation will demonstrate better the meaning of this method. The three unknowns c_1, c_2, c_3, that is, the consumers' cost in dollars per consumer, the kilowatt-hour cost in dollars per kilowatt-hour and the demand cost in dollars per kilowatt per year, are chosen as co-ordinates in a rectangular system of co-ordinates in space in such a way that for example c_1 is measured off in the direction of the X axis, c_2 in the direction of the Y axis and c_3 along the Z axis. In the following terms c_1, c_2 and c_3 will be replaced by x, y and z in order to conform

to the customary symbols of descriptive geometry:

$$\left.\begin{aligned} K_1 &= N_1x + E_1y + D_1z \ldots\ldots \\ K_2 &= N_2x + E_2y + D_2z \ldots\ldots \\ K_3 &= N_3x + E_3y + D_3z \ldots\ldots \end{aligned}\right\} \ldots\ldots (3a)$$

Each of these equations is represented by a plane (Fig. 3) of the general formula

$$K = Nx + Ey + Dz \ldots\ldots\ldots\ldots\ldots (3b)$$

The normal distance of this plane from the origin of co-ordinates O is proportional to K according to the theories of descriptive geometry.

In order to find the co-ordinates x_0 of the point of intersection with the X axis we have to let $y=z=O$. We get then $K=Nx_0$ or $x_0=K/N$. That means the plane intersects the X axis at a distance x_0 from the origin of co-ordinates which represents the amount which each consumer would have to pay if the total expenses would be distributed over all consumers uniformly, without any regard to the kilowatt-hours consumed and to the maximum demand.

In the same manner we get

$$OA_y = Y_0 = K/E$$

which is equal to the average price of the kilowatt-hour if the total expenses are distributed only with regard to the kilowatt-hours consumed and

$$OA_z = Z_0 = K/D,$$

which is equal to the average price of the kilowatt maximum demand at a pure flat-demand rate.

The tangent of the angle A_zA_yO is given by the following equation.

$$\tan \lambda = OA_z/OA_y = z_0/y_0 = E/D.$$

This angle, therefore, equals the load-factor of the central station.

In the same manner one finds that

$$\tan \mu = x_0/y_0 = E/N.$$

This equals the number of kilowatt-hours sold per consumer and that

$$\tan \nu = x_0/z_0 = D/N$$

equals the average maximum demand per consumer.

Every point P located anywhere on the surface of the plane $A_x\ A_y\ A_z$ indicates by these three co-ordinates a set of three charges of x, y and z. If this set of charges is used for figuring the total cost of the central station according to equation 3*b* with the load conditions which actually prevailed during that year the result must coincide with the cost actually expended.

If one now constructs corresponding planes for all three years as done in Fig. 4, they will in general have only one single point in common, their point of intersection P_0. This point indicates by its co-ordinates X_0 Y_0 Z_0, the three charges which would furnish the correct result for every one of the three years if employed for the calculation of the cost. *The distribution of the suppressed functions is made automatically from the point of view that the calculation furnishes proper results for all three years.*

This geometrical representation and also the theory of determinants, show plainly that equations 3*a* have a solution only if the angles λ μ and ν change in the three successive years otherwise the planes are parallel to each other and therefore have no point of intersection except at infinity. It is, therefore, essential that the load-factor, the average kilowatt-hours consumed per consumer and the average maximum demand per consumer vary. If this variation is very small the planes intersect at very acute angles and the determination of the point of intersection becomes inaccurate, a fact which expresses itself in the numerical solution of the equation by the fact that the determinants R, R_1, R_2, R_3 have exceedingly small values in comparison to the positive and negative terms of which the determinants consist. The quotients R_1/R, R_2/R and R_3/R are then for practical purposes equal to O/O and a very small percentage change of one term of a determinant caused by casualties may change the value found for x, y or z respectively by a multiple of its true value and under circumstances may even change their sign.

If for instance in a certain year a repair has occurred which is particularly expensive and occurs only on exceptional occasions—for instance in consequence of a boiler explosion—then the plane for the respective year will be removed away from the origin of co-ordinates O. The plane will, though being shifted, remain parallel to the position it would have otherwise. Thereby the point of intersection of the three planes will shoot out far away from its position on account of the assumed small angles of mutual inclination so that even negative co-ordinates may result.

The requirement of sufficient variation of the angles is generally better fulfilled if, instead of three successive years, three months are chosen at different seasons since, for instance, the load-factor, tangent λ, in summer and in winter reaches entirely different values. The result is further freed from the influence of casual irregularities by choosing not, as assumed heretofore, only three such periods but by

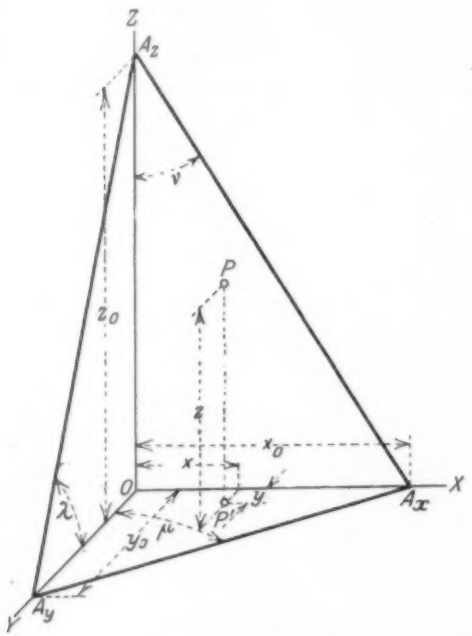


Fig. 3—A Plane of Cost.

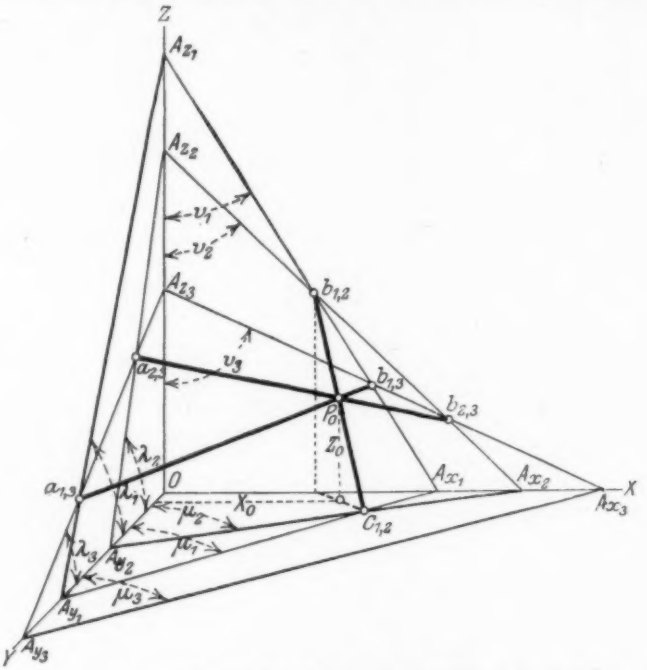


Fig. 4—Planes of Cost for Three Consecutive Years.

extending the calculation over a larger number of periods such as 24 months, with the result that one obtains average values of a larger number of periods.

This results in 24 linear equations with three unknowns There is, of course, in general no solution of the latter possible which satisfies all 24 equations but it is possible to find those values for the unknowns which satisfy the equations in the most accurate way, that is, with which the sum of the squares of the errors becomes a minimum, that is, the most probable value. This is done by the method of Gauss which consists of the following:

The 24 or, in general, n equations be:

$$\left.\begin{aligned} &N_1x+E_1y+D_1z=K_1)\\ &N_2x+E_2y+D_2z=K_2)\\ &\cdots\cdots\cdots\cdots\cdots\\ &N_nx+E_ny+D_nz=K_n) \end{aligned}\right\}(4)$$

Multiply both sides of the first equation with N_1, those of the second equation with N_2, etc., and add the equations which obtained thereby.

This results in a new equation:

$$(N_1^2+N_2^2+\ldots\ldots N_n^2)\,x+(E_1N_1+E_2N_2+\ldots\ldots E_nN_n)\,y+(D_1N_1+D_2N_2+D_nN_n)z=K_1N_1+K_2N_2+\ldots\ldots K_nN_n\ldots\ldots \text{(I)}$$

This equation I is called the first normal equation. Now if we multiply the first one of equations 4 by E_1, the second by $E_2\ldots$, etc., and add them again and we obtain the second normal equation:

$$(E_1N_1+E_2N_2+\ldots\ldots\ldots E_nN_n)\,x+(E_1^2+E_2^2+\ldots E_n^2)y+(E_1D_1+E_2D_2+\ldots E_nD_n)z=E_1K_1+E_2K_2+\ldots\ldots E_nK_n\ldots\ldots\ldots \text{(II)}$$

In an analogous manner we get the third normal equation by multiplying all equations 4 by $D_1, D_2 \ldots D_n$ and adding them, thus obtaining

$$(D_1N_1+D_2N_2+\ldots D_nN_n)\,x+(E_1D_1+E_2D_2+\ldots\ldots E_nD_n)y+(D_1^2+D_2^2+\ldots\ldots D_n^2)z=D_1K_1+D_2K_2+\ldots\ldots D_nK_n\ldots\ldots \text{(III)}$$

The three normal equations can be written in a shorter and more perspicuous manner, as follows:

$$\Sigma(N_m^2)x+\Sigma(E_mN_m)\,y+\Sigma(D_mN_m)z=\Sigma(N_mK_m)\ldots\ldots\ldots \text{(I)}$$

$$\Sigma(E_mN_m)x+\Sigma(E_m^2)y+\Sigma(E_mD_m)z=\Sigma(E_mK_m)\ldots\ldots\ldots \text{(II)}$$

$$\Sigma(D_mN_m)x+\Sigma(E_mD_m)y+(D_m^2)z=\Sigma(D_mK_m)\ldots\ldots\ldots \text{(III)}$$

It is seen that the nine co-efficients of the unknowns are partly identical with each other in couples according to a law of symmetry which can be easily recognized. This makes their computation easier.

These three normal equations solved for the three unknowns x, y and z yield directly the most probable value for the latter, that is the value which approximates the nearest the simultaneous fulfillment of all n equations.

The charges found in that manner require a correction.

The kilowatt-hour charge must be increased in the ratio kilowatt-hours generated/kilowatt-hours sold since only the kilowatt-hours sold are paid out and not, as has been assumed heretofore, the kilowatt-hours generated. On the other hand the demand charge must be reduced on account of the diversity factor. It is, of course, here again impossible to be fair to every consumer and we have to be satisfied to distinguish the consumers by classes, for instance, residences, stores, offices, etc.; also various classes among the power consumers such as small-trades people, factories, pumping plants, street railways, etc. For every one of these classes the average value of the ratio m = kilowatt demand at peak load/absolute maximum demand in kilowatt-hours is found by either estimating or preferably putting up recording ammeters on the premises of a number of consumers. The value for the demand charge z is then multiplied by the value of m which is valid for the respective classes of consumers. The term z should also be corrected further in an analagous manner on account of the capacity lost in transmission and distribution.

It will be commendable to leave out one or the other charge in the rates for some classes of consumers. Thus for instance, the pure flat-demand rate ($x=y=0$) particularly with current limiters has large advantages on account of its soliciting power for small lighting consumers, as is being found out more and more during the last few years. On the other hand, current for railways is frequently sold at a pure kilowatt-hour rate ($x=z=0$). Applying the load curve of the respective class of consumers, which curve may be either known or assumed, one can then easily, in these cases, distribute the suppressed charge among those which are maintained.

If the total costs K which are at the basis of the whole calculation have been assumed in such a manner, as has been indicated above, that a certain minimum interest for the stock has been included, this dividend can be expected if the values found for the three expenses are introduced unchanged as charges into the rate schedule. An increase of these charges for profit will then serve for increasing the dividend. It is an exceedingly subtle question how high the most favorable increase for profit is, that is the increase with which the maximum of gross profit results. The answer to this question is beyond the scope of this article.

Certain classes of consumers will have to be charged with a special low price since otherwise they cannot be acquired as consumers. This today, since the general introduction of the metallic-filament lamp, is true not so much for the very small consumers who in general are the poorest classes but for the very large ones because these are in a position to erect an isolated plant. The rates of the central station have to compete, therefore, with the cost of an isolated plant of that kind and may have to be lower than the average. For these extra low rates an exact knowledge of the cost is of the greatest importance.

The method described is of course not restricted to the number of three charges as one can also aim from the beginning at the application of two charges only, for instance a kilowatt-hour charge and a demand charge and then one obtains only two unknowns, y, z in the equations. With such central stations which are also enterprises for operating railways one could add two unknowns, namely, u, that is, that part of the cost of railroad operation which is proportional to the number of car miles and v, that is, that part which is proportional to the length of track. It should be understood, however, that the calculation of five unknowns out of about 24 equations is a rather lengthy operation even with the use of competing machines and it is probably preferable to separate the railway cost from the beginning entirely from the central station cost if possible. The expenses which are common to both enterprises such as general expenses, must then be distributed arbitrarily by estimation. Each one of the two groups is then to be resolved into its parts after the analytic method described above.

As regards the length of the period over which the computation should be extended it must not be too small so that casualties do not exert a disturbing influence and that a proper average value can be found. On the other hand it must not be too large since the amount of the cost for the separate charges is slowly changing in the course of the years in consequence of the development of the central station. About 24 monthly periods will probably be the proper number of periods under ordinary circumstances. If, during that time, a change of rates has occurred this influences favorably the accuracy of the computation since thereby the character of the use of current by the customers is changed. This means that the planes will intersect at less acute angles which makes possible, as shown above, a more exact computation of the unknowns.

If the computation should show that the ratio of the three charges deviates very much from those in the existing schedule and if a change should appear advisable one must proceed with the change of rates only cautiously and by steps since every change of that kind will result in a change of the character of the load and may react thereby on the cost.

The method described in this article is new and has been developed on the basis of experiments which have been made with its application to practical cases. It cannot be applied as a rigid rule and in detail it has to be adapted to the peculiarities of the respective central stations.

New Electrical and Mechanical Appliances

A Novel Form of Indicating Fuse Plug.

The Premier Electrical Manufacturing Company, Bridgeport, Conn., has placed on the market a two-piece porcelain plug with brass shell, for standard cutouts and entrance switches. The chief claim for novelty in this fuse plug is its indicating feature. By a combination of a phosphor-bronze spring and fiber piston a blowout from either a short-circuit or overload would release the spring and drive out through the porcelain cap a pin until it protrudes about one-quarter of an inch on the outside of the plug. This gives a clear and absolute indication that the plug has blown out. In this connection the company has adopted the slogan "you can tell in the dark."

New Fuse Plug Before and After Indication.

Even though there be no light, if access is available to the cabinet or cutout in which the plugs are installed, the protruding pin will indicate the blown fuse plug and a new one can be installed in its place. The plugs are rated at 125 volts, from three amperes to 30 amperes, inclusive.

New Sizes of British Half-Watt Lamps.

Several British manufacturers have announced reduced prices and additional sizes of gas-filled or "half-watt" tungsten lamps. These are now furnished in the following sizes: for 50 to 65 volts, 100, 200, 300 and 500 watts, of which the first two are new sizes; for 100 to 130 volts, 200, 300, 500, 1,000 and 1,500 watts, of which the first two are new sizes; for 200 to 255 volts, 500, 1,000 and 1,500 watts, of which the first is a new size. The reduction in list prices of the older sizes ranges from 14 to 20 per cent.

Federal High-Efficiency Equipment.

High-efficiency gas-filled incandescent lamps of 750 and 1,000 watts are equipped by the Federal Sign System (Electric), Lake and Desplaines Streets, Chicago, Ill., with reflectors and mountings suitable for both outdoor and indoor use. An outdoor installation of the new type is illustrated in Fig. 1, which shows the entrance to the Young Men's Christian Association Building in Chicago.

Fig. 1—Entrance Lighted by Gas-Filled-Lamp Fixtures.

The reflector is of porcelain-enameled steel, 18 inches in diameter, with the inner surface white and the outer surface black. It is equipped with a Mogul-base socket and a diffusing bowl which surrounds the lamp. The latter is of opal glass 10 inches in diameter. This diffuser may be omitted where the unit is suspended at such a height that there is no danger of glare. The fixture can be suspended by a one-half-inch pipe stem or goose-neck bracket. It may also be suspended from overhead cables.

The indoor lighting unit is illustrated in Fig. 2. The glass diffuser in this case is hemispherical and has a diameter of 12 inches. The shade above it is of opal glass 20 inches in diameter. The brass dome above the shade contains a Mogul socket and has ample opening for ventilation. The Mogul socket is set in a white porcelain-enameled steel disk, which acts as a reflector for such rays as would otherwise be lost in the dome. The standard fixture is suspended by an 18-inch stem with one-inch brass casing and 6.5-inch canopy, but longer stems can be provided. The standard finish for the metal parts is brush brass.

Fig. 2—Federal Indoor Fixture for Gas-Filled Tungsten Lamps.

Self-Starting Alternating-Current Motors.

A new line of self-starting induction motors has recently been developed and put on the market by the Electric Specialty Company, Stamford, Conn.

In these motors the usual starting clutch has been dispensed with, owing to the inherent difficulty arising

from its use, and a special split-phase winding has been used, which gives a starting torque and overload capacity of 175 per cent or more of the full-load ratings.

Special attention has been given in the design and construction to eliminate all magnetic hum, thus making the motor especially adapted to musical-instrument work and the driving of general household and office appliances where such noise is objectionable. Special attention has also been given to temperature rise, which does not exceed 30 degrees centigrade.

These motors are built in sizes of from one-tenth to one-third horsepower, with large underfeed wick oil cups, the oil being fed through a special soft one-quarter-inch wick. The same general type of motor is also built in sizes of from one-sixth to one-half horsepower, with oil ring bearings.

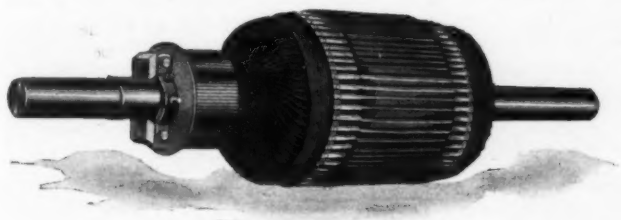


Fig. 1—Rotor of Bell Compensated Motor.

Compensated Type of Polyphase Motor.

An interesting type of induction motor is now being built by the Bell Electric Motor Company, Garwood, N. J. This motor is of the compensated type and is built for two and three-phase current. No starting box or compensator is used, the starting of the motor being entirely automatic.

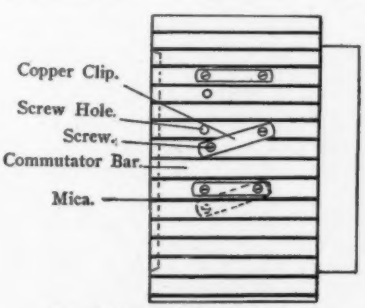


Fig. 3—Commutator of Motor.

The rotor of this motor is shown in Fig. 1. It has two windings, the upper one being of the high-resistance squirrel-cage type. This winding is used to bring the motor up to speed. Under this winding is a coil winding which is somewhat similar to that employed upon a direct-current armature. This winding is connected to a commutator which is short-circuited by a special short-circuiting plate when the motor obtains approximately full speed. The motor then operates with two rotor windings, the currents of which are not in phase with each other. These windings are said to react upon the stator in such a way as to increase the power-factor of the motor.

The commutator used in connection with the lower winding is provided with no brushes but with a short-circuiting plate as previously described. This commutator is also provided with a number of copper clips as shown in Fig. 3. By connecting one or more of these clips across adjacent commutator bars, portions of the lower winding of the rotor copper are short-circuited, thus putting more copper in the rotor while starting, with a resultant increase in starting torque. These motors operate under load with very little slip and with high efficiency and power-factor.

These motors are well adapted for use where polyphase induction motors that will start with very little inrush of current are desired. They are especially well adapted for use with float-controlled pumping machinery, etc., where the main switch is automatically opened and closed. In all cases a double-pole knife switch is the only controlling apparatus required. The closing of the switch will cause the motor to start without having any appreciable effect on the line voltage. No fuses are short-circuited during starting as is sometimes the case where a starting compensator is used.

These motors are coming into extensive use. Fig. 4 shows a motor-generator set of the type furnished by this company to the United States Government for installation on the battleship *Wyoming*. This comprises a polyphase motor and a direct-current generator.

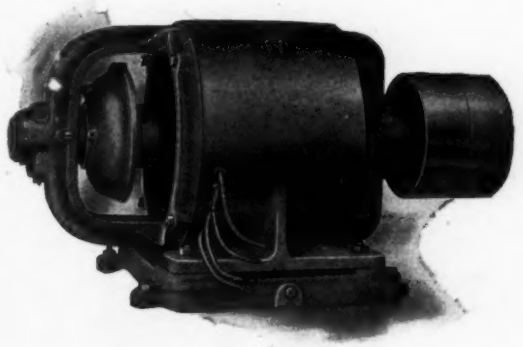


Fig. 2—Compensated Polyphase Motor Complete.

Turbogenerators for Lighting Steam Shovels.

The Utah Copper Company has recently ordered six one-kilowatt Westinghouse turbogenerators for supplying electric light for steam shovels operating in its copper mines at Bingham, Utah. These machines are bolted direct to the shovel frame and supplied with steam from the shovel boiler. The company has for some time been trying one of these units and has found that many shutdowns were avoided during night operation by making each shovel carry its own lighting outfit. This has done away with the difficulty connected with maintaining electric lighting lines in the vicinity of frequent blasting operations.

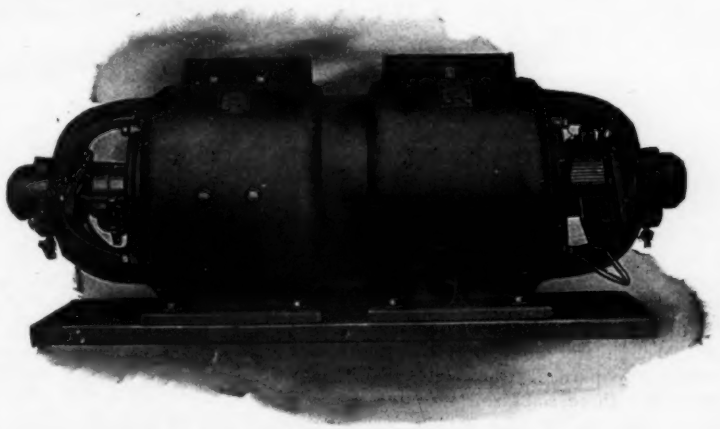


Fig. 4—Bell Motor-Generator Set.

New White Electric Washers.

The rapidly increasing use of washing machines has stimulated manufacturers of these devices to keep adding new types from time to time. One of the largest and best known manufacturers of washing machines of all kinds to suit various conditions and tests is the White Lily Manufacturing Company, Davenport, Iowa. This company many years ago began to specialize in the manufacture of washers and the White Lily early established for itself a desirable reputation. The company has recently added to its extensive line two new types of electric washers.

The first of these is known as White's De Luxe electric washer. A general view of this is shown in the accompanying illustration. This machine is made in three different sizes, having a capacity of 8, 12 and 16 sheets, respectively, or double that number of shirts. The one shown in the illustration is known as the Style A. Its floor dimensions are 28 by 30 inches, and the height of the machine is 36 inches. This makes a very compact outfit and one that can be readily taken through any door without dismantling any part of the equipment. Each of the three sizes referred to is made in two styles, one having the body tank made of special rolled zinc and the other having this made of polished copper, which is tinned on the inside.

White's De Luxe Electric Washer.

This machine is of the cylinder type, the cylinder in the size shown being 21.5 inches in diameter and 20 inches long; it is made of well seasoned, hard maple. Inside the cylinder are shelves which carry the clothes through the water in the bottom of the stationary tub as the cylinder is rotated, and the water passing through the holes of the cylinder drags the dirt out of the pores of the clothes. The cylinder has a lid which is closed after the clothes have been placed within and is fastened by two tinned buttons. By raising a gear lever the cylinder is immediately brought into action; it makes a complete turn in one direction, is automatically reversed and makes a complete turn in the other direction, continuing this cycle for from five to fifteen minutes, which has been found ample for cleaning any batch of clothes. It has been found that the reversal at each complete revolution causes very effective agitation of the clothes and soap water and does away with the tendency for the clothes to become rolled up in a ball or roll, as is likely to happen if the cylinder runs too long in one direction. The motor and mechanism of the machine are placed beneath the tub so as to be entirely out of the way. The motors are especially built for this purpose and are of ample power to operate the machines under the most severe conditions. All metal parts of the machine are strongly made and thoroughly protected against rusting. The framework of the machine is well braced and the castors at the bottom are of the swivel type to permit moving the machine about easily. The wringers have rolls 12 inches long and 1.75 inches in diameter. The gearing of the wringer is protected.

Another type of machine, known as the White Way platform electric washer, has also been placed on the market by this company. This is made in two sizes, each of which has a width of 31 inches and is 34 inches high; the No. 1 machine has a total length of 76 inches and the No. 2 machine 100 inches. This type of machine is designed for those laundries where no stationary tubs are provided and in which it is desired to mount all of the washing, rinsing, bluing and wringing equipment on one platform. The manner in which this is done is shown in the illustration herewith. An adjustable slide at the extreme right end can be pulled out to carry the clothes basket. The wringer is mounted on a movable carriage which can be moved over any of the tubs and thus permit wringing from the washing machine to the rinsing tub or from the rinsing to the bluing tub or finally into the basket. The washer itself is of the dolly type and the machine will wash a batch of clothes in from 10 to 15 minutes, depending upon the condition of the clothes. The dolly block is of larger size than that usually provided in rotary machines. The capacity of the machine shown is six sheets or 12 shirts. The motor equipment is similar to that of the De Luxe washer previously described. The platform is of very substantial construction.

White Way Platform Electric Washer.

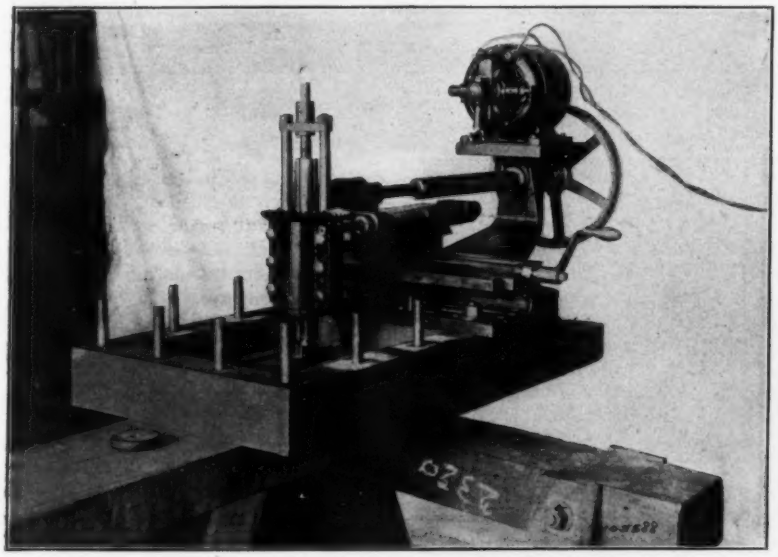
Compact Gas-Engine-Driven Generating Set.

An electric generating plant weighing complete only 350 pounds, and which will generate enough current to supply 80 lamps of 16 candlepower each, is just being placed on the market by the Okey Manufacturing Company, Columbus, O. The engine is not much larger than that of a small automobile. It is self-starting and runs with either gas or gasoline fuel. The plant is said to be the smallest ever put into practical use. It is adaptable for all purposes to which electricity may be applied in the home, such as cooking, washing, water-heating and vacuum-cleaning. The operation is more noiseless than that of improved automobile motors. The plant is the outcome of several years' experiment on the part of Perry Okey, who has invented several devices now used in automobile manufacture. A low running cost is one of the claims made for it. Before being introduced to the market the miniature plant was subjected to a series of exacting tests, and is now a pronounced success.

A Portable Milling Machine.

The illustration shows a machine of a new design that will be found very convenient for a great variety of purposes. It is a portable milling machine suitable for being carried to the work and mounted on it, so that it can handle many jobs that on a regular milling machine would be awkward or would require dismantling and removal of the part that is to be worked on.

In the illustration the machine is seen milling the seat and port edges of an engine valve and the method of mounting, by means of bolts through longitudinal slots in the base, is clearly shown. It can be mounted vertically as well as horizontally.



Portable Milling Machine.

The spindle stands clear of the base so that the work is not smothered. Its longitudinal travel is 12 inches, cross travel six inches, and vertical adjustment six inches. Hand adjustment is provided for the longitudinal and cross travels in order to avoid the weight and complication necessary with automatic adjustment.

All parts are made strong and rigid, and the work done by the machine is first class in every respect. It is especially useful for milling engine and pump valve seats, port edges, key seating shafts, facing pads on large frames, etc. It will also drill, although not designed for the particular purpose. A special attachment with V-shaped seats can be supplied for mounting the machine on shafts for key seating.

Power is supplied by a one-quarter horsepower Westinghouse Electric motor of 1,725 revolutions per minute. The machine is manufactured by the Pedrick Tool & Machine Company, Philadelphia, Pa.

Excellent Life Performance of Mercury-Arc Rectifier Bulbs.

Some excellent reports have been received recently on the life of Westinghouse-Cooper Hewitt mercury-arc rectifier bulbs used on constant-current arc-lighting circuits. These bulbs are guaranteed for an average life of 500 hours, but this is very generally being exceeded; in some instances an average life as high as from 8 to 15 times the guarantee has been obtained.

The recently issued report of the Peoples' Gas & Electric Company of Savanna, Ill., is an excellent example of what results are often obtained with but slight attention on the part of the operators. This report showed an average bulb life for the last three years of 8,398 hours. This figure is not the extreme life in a few individual cases, but the average life of all the bulbs in the installation; some of the bulbs still in service are operating in the neighborhood of 9,000 hours. T. P. Bowen, manager of this plant, attributes this extra long average life to the fact that the bulbs are, according to the instructions of the manufacturer, operated on short-circuit for four or five minutes each night before throwing on the lamps. In addition to this treatment, the bulbs are occasionally taken from the tank and "rested" for a week or more and are also given an occasional hot-water bath.

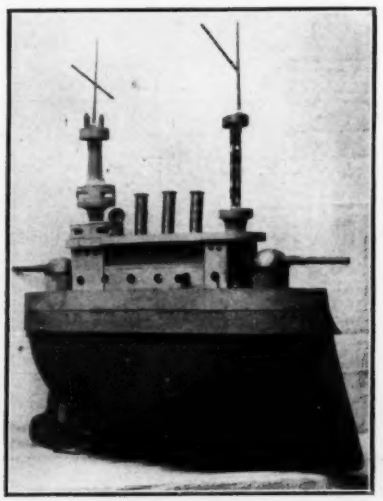
Outing of Crocker-Wheeler Employees.

The Crocker-Wheeler Club, composed of employees of the Crocker-Wheeler Company, Ampere, N. J., held its annual seashore excursion at Asbury Park, August 8. About 2,000 members and guests participated.

Wireless Control of Torpedo Boats and Other Vessels.

One of the most attractive problems in wireless work is that of automatic steering of vessels from the shore by means of the electric waves, and inventors in different countries have been exercising their ingenuity in this direction, sometimes being quite successful in handling either a small model or a good sized boat. In view of the extraordinary interest in naval affairs, a number of methods will be referred to in this article.

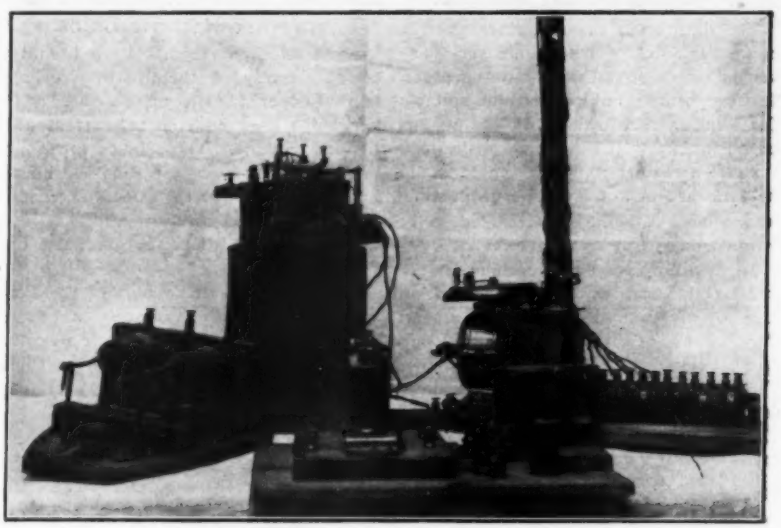
A well worked out and at the same time simple method which Mr. Brunet, a French inventor, employs has been applied to a little model, which is shown in the accompanying illustration. Inside the miniature warship are the various electric devices which serve to steer and propel the boat. It can be easily controlled from the wireless apparatus placed on shore. Without going into the details of the different devices, the inventor uses a small electric motor to run the propeller, while the rudder is turned to one side or the other for steering by the use of a pair of electromagnets. On the boat is a drum which is rotated by clockwork and carries sets of contacts. One of the original features of the boat is the use of a hollow mast which is seen on the right, carrying several colored lamps spaced along it. When the drum revolves it sends current into the lamps in succession, so that we see a red light, then a blue, and so on. This tells the operator on shore just when he can send a wave for acting on the wireless apparatus in the boat, for when the red light is on, this means that the drum has also thrown the electric contacts upon the propeller motor. But no current goes to the motor unless the operator sends



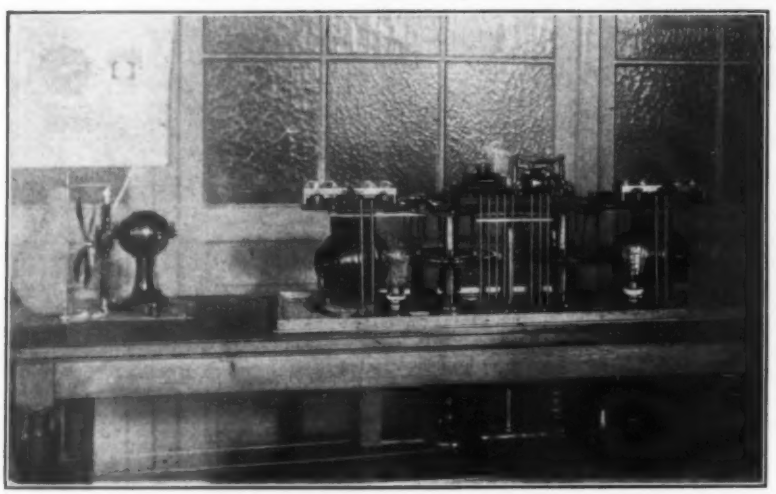
Model Boat Used in Brunet Wireless Control Experiments.

a wave at this time, and when he does so, the wave acts upon apparatus similar to what is used in wireless telegraphy in order to put the current of a small battery onto the motor. Thus the motor continues to run until the operator chooses to send a second signal at the time the red light comes on again, and this cuts off the motor by a reverse action. Again, when the green light is seen, all is in position for working the rudder to the right, and white light, to the left. At each end is a cannon or torpedo tube, which can be put in operation at any time when other colored lamps come on to show the right moment. By this simple method the operator can control the boat even when it is at quite a distance from shore and put it through different movements.

Some very successful work in the way of handling vessels by wireless has been carried out by a well-known Spanish engineer, Mr. Torres Quevedo. The illustration herewith shows a good sized model of the apparatus which was used in an electric launch large enough to hold a number of persons. On the left will be seen an electric motor for running the propeller, while the rudder lying in front of it is steered by cord and pulley from below. The apparatus at the middle part is run by two electric motors, one of which serves for turning the rudder, while the second motor operates a rotating controller contact drum and various other parts. At the top are the electromagnets as well as the wireless apparatus which serves to receive the waves sent from shore by the operator. At the time of bringing out his method, the apparatus awakened such a great interest in scientific circles that the Government decided to award a subsidy of $40,000 to the inventor in order to enable him to put the method into practice on an actual vessel, which he accordingly did at a later date, and made quite a sensational performance in the outer harbor of Bilbao with his boat containing several persons, journalists among others, on board. The shore station was laid out upon the flat roof of the Maritime Club, and he had no difficulty in making the boat answer to the wireless impulses which he sent out.

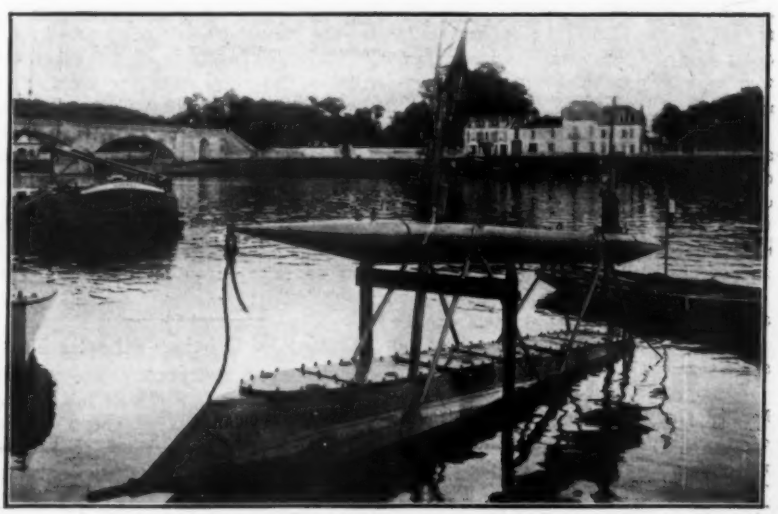


Brunet Wireless Boat-Steering Apparatus.



Torres Quevedo Boat-Steering Apparatus.

In this connection there may be mentioned Mr. Gabet's "radio-automatic" torpedo, which the inventor tried at various times upon the Seine near Paris, France. Part of the apparatus is contained in an upper long float and the rest within the torpedo itself. Wireless waves cause the torpedo to sink so that only the float remains above water, and lamps upon the mast can be lighted up so as to



Gabet Radio Automatic Torpedo Craft.

Fig. 1—Roycrofter Lighting Fixtures in Park Grove Inn Lobby.

indicate its position. Thus the operator is able to raise or sink the torpedo, run or stop it, and steer it in all directions. Mr. Gabet's method appears to be one of the best that has made its appearance as yet.

Lighting of the Grove Park Inn.

The Grove Park Inn, at Asheville, N. C., is one of the finest resort hotels in the world. In its construction the best of materials of all kinds were used throughout.

The lighting system in the building is almost entirely indirect. Over 600 lighting fixtures were wrought in copper by hand by the Roycrofters at East Aurora, N. Y. Fig. 1 shows the fixtures in the large hotel lobby and Fig. 2 illustrates the bedroom equipment. These indirect fixtures are equipped with reflectors of the National X-Ray Reflector Company. The typical bedroom contains a single indirect fixture suspended 30 inches from the ceiling and containing a single 150-watt lamp.

The lobby is 80 feet wide and 120 feet long, and contains 12 fixtures, each equipped with nine 150-watt lamps and reflectors. The ceiling is 16 feet high and the fixtures are suspended 5.5 feet from the ceiling. The total candlepower of the equipment in the lobby is over 12,000.

The main dining room is divided into two portions, in one of which there are four and in the other three fixtures each containing seven 150-watt tungsten lamps. These are suspended at the same height as those in the lobby.

In the corridors, illuminated bowls of low intensity are used. One of the corridors is illustrated in Fig. 3.

Cleaning of the hotel is done with a Sturtevant vacuum cleaner operated by electric motor.

Fig. 2—Indirect Fixture in Bedroom of Inn.

Fig. 3—Illuminated-Bowl Fixtures in Corridors.

Louisville Tennis Club.

A tennis club organized among the employees of the Louisville (Ky.) Gas & Electric Company has been presented with three clay tennis courts, constructed by the company. There are 34 members of the club with the following officers: President, W. G. Beck; vice-president, Walter Forbes; secertary and treasurer, McKay Reed. Officers of the company have offered prizes for the winners of the various tournaments to be held: silver cup, gold medal, three tennis racquets, three pairs tennis shoes, and others.

Current Electrical News

NORTH ATLANTIC STATES.

LITTLETON, MASS.—The municipal electric light plant will extend its lines on the Great Road as far as Lake Nagog, at a cost of about $2,000. W.

NORTH ADAMS, MASS.—It is announced that work will soon be started on a large power house for the Hoosac Cotton Mills. A large addition to the plant will also be built. The amount to be spent for buildings and machinery is said to be over $1,000,000.

NEWPORT, R. I.—A communication has been received from Street Commissioner Hamilton asking that new electric lamps be installed in Third Street, so that the gas lamp posts may be removed from the middle of the roadway. Alderman Hughes said it seemed to him that the Newport & Fall River Street Railway Company should make application for the poles, etc., on Third Street.

CORNING, N. Y.—The Chamber of Commerce is planning ways and means to improve the lighting system. Address Willard S. Reed.

JERSEY CITY, N. J.—The Board of City Commissioners has made an appropriation in its budget for the fiscal year for the establishment of an improved street-lighting system, forming a "White Way" on upper Newark Avenue. A.

NEWARK, N. J.—The Board of Freeholders will receive bids until August 26 for the installation of a new water-tube boiler and apparatus in the boilerhouse, Overbrook Hospital. Runyon & Carey, 845 Broad Street, are engineers. A.

ELWOOD CITY, PA.—A survey is being made to enter the electric service to the Hazel Dell suburb. City Electrician Friedoff may be addressed in regard to the matter.

SOUTH ATLANTIC STATES.

WESTMINSTER, S. C.—The city will vote on the construction of an electric light plant. Address the mayor for general information.

DELRAY, FLA.—A municipal electric light plant will be established here. A. F. Miller is mayor.

FROSTPROOF, FLA.—Residents of Frostproof will organize a stock company to develop electricity from waterpower to furnish power and light here. C. W. Brown is general manager.

OVEIDO, FLA.—An electric light plant may be established here by M. M. Smith and associates.

NORTH CENTRAL STATES.

MILES, O.—The Board of Control will make extensive improvements to the electric light system. Address Mayor Bryan for information regarding same.

POMEROY, O.—The Wilmington, Delaware & Columbus Railway Company, operating a line of electric interurban railway between Middleport, Pomeroy and Racine, O., has taken out a new charter, under the name of the Ohio River Electric Railway & Power Company, and is said to be considering the extension of its business to include supplying current to the towns along its system. L.

LOGANSPORT, IND.—Cluster lighting will be established on Burlington Avenue. Address the city clerk for particular information.

RICHMOND, IND.—An ordinance has been passed by the Council appropriating $16,000 out of the funds of the municipal light plant for the construction of a new street lighting system.

MT. STERLING, ILL.—The city's contract with the Central Illinois Public Service Company expires within a short time. A company will be organized by the business men for the purpose of installing an electric light plant. Address the city clerk for general information.

SULLIVAN, ILL.—A $35,000 electric light plant will be installed here. Address the city clerk for further details.

SAGINAW, MICH.—Petitions are being circulated here requesting the council to submit to the voters at a special election the question of bonding the city for $200,000 to build and operate a municipal electric light and power plant.

MONTELLO, WIS.—The Montello & Harrisville Light & Power Company has been incorporated with a capital of $40,000.

ST. JAMES, MINN.—$20,000 will be spent in remodeling and installing a new plant for a 24-hour service here. C.

AURELIA, IOWA.—Aurelia will hold a special election on August 17 to vote on a proposed bond issue of $7,000 for the erection of a light and power plant. The current is to be obtained from Cherokee if the plant is built. Address the town clerk.

CHARLES CITY, IOWA.—A 25-year franchise has been granted to the Charles City Lighting & Heating Company. Address the general manager for desired information.

DAYTON, IOWA.—At a recent election it was decided to grant a franchise to the Central Light & Power Company, of Bonne, to install an electric system in Dayton. Address the town clerk.

EARLHAM, IOWA—$8,000 will be expended improving the light and water system. Address the city clerk for particulars.

SERGEANT BLUFFS, IOWA — Plans are being prepared for a municipal electric lighting plant to cost about $10,000. Bonds will be issued at an early date.

SIOUX CITY, IOWA.—Funds are being raised for a large electrical arch on the viaduct. Address the city clerk in regard to this proposition.

AUXVASSE, MO.—M. R. Kennedy has applied for permission to install an electric light plant here.

ARMOUR, S. D.—G. W. Welch, civil engineer, is making plans for a central lighting plant for the Interstate Power Company.

HETLAND, S. D.—The Lake Preston Milling Company has been granted a 20-year franchise permitting the construction and maintenance of a line for the transmission of electricity between Lake Preston and De Smeta.

LAKE PRESTON, S. D.—The Lake Preston on application of E. G. Ostroot, president, has been granted a 20-year franchise permitting the construction and maintenance of a line for the transmission of electricity between Lake Preston and DeSmet.

GARNETT, KANS.—The city of Garnett has voted bonds to the amount of $15,000 for a municipal electric plant, and is advertising for bids for the construction of the plant.

KIOWA, KANS.—The Council will expend $14,000 remodeling the electric light system. Address the city clerk for particulars.

SOUTH CENTRAL STATES.

BURKESVILLE, KY.—The Burkesville Light & Power Company has been incorporated with a capital of $2,000, by J. P. Smith, C. W. Alexander, Dix McComas and George Greenup.

LOUISVILLE, KY.—The Louisville Sand & Gravel Company, recently incorporated with $7,500 capital, will install electrically operated equipment. M. M. Renn, of the Renn Coal Company, is one of the incorporators. G.

LOUISVILLE, KY.—About 400 horsepower of motors will be purchased by the Kentucky Cotton Yarn Company, which is to equip and operate a cotton-yarn factory here. I. F. Phillips is manager of the company, which has an authorized capital of $200,000. G.

LOUISVILLE, KY.—At least one 20-horsepower motor will be required in the new $5,000 grain elevator which Henry Fruechtenecht is building in Louisville.

MIDDLETOWN, KY.—A fund subscribed to by citizens of this unincorporated community will pay for street lighting, the current to come from the Louisville Gas & Electric Company, of Louisville, Ky.

MONTGOMERY, ALA.—The Reeves Owen Electric Company has been incorporated with a capital stock of $5,000, by R. P. Reeves of Selma, who is president; Hopson Owen, of Montgomery, and others.

NEW ORLEANS, LA.—The People's Association recently adopted reso-

lutions advocating the erection of a municipal lighting plant and strenuously opposing a contract with any corporation for the new lighting arrangement.

BOGOTA, TEX.—A stock company is being formed here for the purpose of putting in an electric light plant. Roy Riggs of Brownwood is promoting the company.

THREE RIVERS, TEX.—At a meeting of the Board of Directors of the Hamilton Townsite Company it was decided to install a modern 25-kilowatt alternating-current electric light plant for the town of Three Rivers. Address the mayor in regard to this project.

WESTERN STATES.

HAVRE, MONT.—Havre Electric Company plans to expend $50,000 on improvements in this city; plans and specifications will soon be out for the new telephone exchange building.

SALMON CITY, IDAHO.—Articles of incorporation have been filed by the Salmon River Light & Power Company. The officers are: C. L. Mackenzie, president; H. H. Boomer, vice-president; W. A. Monroe, secretary; R. Irvin, treasurer, and E. Riggs, general manager. Arrangements have been made with the Spokane & Eastern Trust Company of Spokane to float a bond issue of $125,000. The new plant will be modern and complete and will furnish enough power for present and future needs. U.

TELCHACE, ARIZ.—F. G. Baum, an engineer of San Francisco, Cal., and associates, will construct a large dam across the Little Colorado River near here and erect a hydroelectric plant which will provide power for operating mines and other industries covering a wide district of the state. It is proposed to construct transmission lines to Globe, Hayden and Ray, more than 175 miles distant from the site of the proposed main power plant. The dam will impound 447,500 acre feet of water and will afford a sufficient supply to irrigate a large tract of land. Mr. Baum has filed the plans for the works in the state land office at Phoenix. D.

EDMONDS, WASH.—The County Commissioners of Snohomish County recently granted a franchise to the Edmonds Light & Power Company, of Edmonds, to extend its transmission lines in and around this city. It is understood work will begin at once. O.

EVERETT, WASH.—The County Commissioners have granted franchises to the town of Sultan for a pipe line across the Skykomish River, and to the Edmonds Light & Power Company for an extension of its lines.

SEATTLE, WASH.—The Committee on Municipal Affairs of the Central Labor Council, in a communication addressed to the County Commissioners of King county, stated that the Central Labor organization heartily favored the installation of a lighting and heating plant in the new million-dollar courthouse under construction. Other organizations have endorsed this proposition, and the Commissioners have taken the matter under consideration, according to current reports. O.

STEILACOOM, WASH.—Bids for furnishing materials and constructing an electric transmission line from the city limits of Steilacoom to the city limits of Tacoma, will be received shortly by Town Clerk Joseph Bowron. O.

TOLEDO, WASH.—The last survey for the extension of a power line from Winlock to this city, made by the Independent Electric Company has been completed, and it is understood work of building the line, which will give this city a 24-hour lighting service, will begin in the immediate future. This company is a subsidiary of the Washington-Oregon Corporation. O.

RIDDLE, ORE.—It has been definitely announced that an electric power transmission line will be built into this city, *via* Canyonville, from Fernvale, by the Oregon-California Power Company, the cost of which is approximately $50,000. An official of the company is authority for the statement that the line will eventually be extended as far north as Roseburg, and that work on the initial project will be started shortly. O.

SALEM, ORE.—August Guiard, representing capitalists, has applied to the State Water Board for permission to develop a water power project on Hood River, near the city of Hood River. The current generated is to be sold to the small towns and residents of the Hood River Valley. Mr. Guiard asserts a 2,000-horsepower plant will be built as soon as the required permission is obtained. O.

ANAHEIM, CAL.—City officials are contemplating the installation of an ornamental street lighting system.

LOS ANGELES, CAL.—The Board of Supervisors of Los Angeles County will receive bids until August 24 for installing and maintaining additions to the street lighting system in the Lankershim lighting district.

LOS ANGELES, CAL.—C. H. L. Ghriest was the only bidder for installing a lighting system in Victorville. His bid has been taken under advisement.

PROPOSALS.

MOTOR-DRIVEN PUMPS.—Sealed proposals will be received at the office of the General Purchasing Officer, Panama Canal, Washington, D. C., until August 17, for furnishing under Circular 863 several motor-driven pumps. For further information address F. C. Boggs, colonel, corps of engineers, United States Army, general purchasing officer.

ROENTGEN-RAY MACHINE. — Sealed proposals will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until September 1 for furnishing one Roentgen-Ray Machine, 110 volts, high-frequency apparatus, and lead screen, as per Schedule 7173, for delivery at the Navy Yard, Philadelphia, Pa.

CABLES, CONDUITS, SWITCHES, ETC.—Sealed proposals will be received by the Department of the Interior, Washington, D. C., until August 25 for furnishing labor and material required for installation of conduits, cables, manholes, switches, circuit breakers, etc., and connecting same ready for use in F Street, N. W., and in the old post office and pension office buildings, Washington, D. C. For further information address B. O. Sweeney, assistant secretary.

FIRE-ALARM GLOBES.—Sealed proposals will be received by Ray Palmer, Commissioner of Gas and Electricity, Chicago, Ill., until August 19, for furnishing and delivering to the Department of Gas and Electricity, City of Chicago, fire-alarm globes for flame-arc and tungsten lamps, strictly in accordance with specifications and drawings on file in the office of said official. Proposals must be made out upon blanks furnished by the Commissioner of Gas and Electricity, inclosed in sealed envelopes; addressed to him and endorsed "Proposals for Fire-Alarm Globes."

NEW PUBLICATIONS.

MISSOURI REPORT.—The Public Service Commission of Missouri has published advance sheet No. 3 of Vol. I, dealing with cases determined during the year 1913-1914.

PUBLIC SERVICE PROPERTIES. —W. S. Barstow & Company, Incorporated, New York City, has issued a well printed and bound booklet describing the public utility properties operated by the company. These are 47 in number and represent yearly gross earnings of over $4,000,000.

PANAMA-PACIFIC EXPOSITION.—The Panama-Pacific International Exposition Company has issued an attractive booklet dealing with the Panama Canal, the exposition which is to be held to commemorate its opening, San Francisco, etc. It is handsomely illustrated with colored views of the exposition buildings.

TERRESTRIAL MAGNETISM. — The United States Coast and Geodetic Survey has issued special publication No. 20, which gives the results of magnetic observations made by the Survey during 1913, together with the results of observations made in the Philippine Islands in 1912. This publication covers 52 pages with full tables and detail data of the various points where observations were made.

CENSUS REPORT ON TELEPHONES AND TELEGRAPHS.—The Bureau of the Census, Washington, D. C., has published as a 26-page pamphlet Bulletin No. 123 giving the census report on telephones and telegraphs for the year 1912. This covers all commercial, mutual, co-operative, farmers' and rural lines, but does not include lines used exclusively for private or interconnecting purposes. A summary of the data given was published in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of March 7, 1914.

SAFETY FIRST IN THE UTILITY INDUSTRIES.—The Southwestern Electrical and Gas Association, Galveston, Tex., has issued a pamphlet entitled "Safety First" which is a symposium of the subject from the viewpoint of the street and interurban railway, the electric light and power plant, the gas plant, the claim department, the press and the public. The pamphlet is a reprint of papers presented on the subject at the tenth annual convention of the association in Galveston, Tex., May 20-23, 1914.

HYDROELECTRIC POWER COMPARED WITH STEAM.—The Bureau of Public Service Economics, 17 East Thirty-eight Street, New York City, has had reprinted in pamphlet form the paper with this title that was presented by Reginald Pelham Bolton before the American Society of Heating and Ventilating Engineers. The paper asserts that hydroelectric power is seldom as cheap as steam power and that the claim that development of water powers promotes conservation of fuel supplies is without basis. Economy in the use of fuel is urged as a true conservation measure.

FINANCIAL NOTES.

Gross receipts for Boston Elevated for July made a fair gain of $24,400, or 1.5 per cent, compared with $38,000, or 2.8 per cent in June and $85,000, or six per cent in May.

To enable it to unify its interest-paying periods, the Dayton Power & Light Company has been authorized by the Ohio State Public Utilities Commission to issue $1,257,000 five-per-cent bonds, dated June 1, 1911. These bonds are to be exchanged at par, for an equal amount of five-per-cent bonds of the Dayton Lighting Company, dated March 1, 1907. The Dayton Power & Light Company now owns the property of the lighting company.

For the purpose of providing for the refunding of the debt of the A. L. Sweet Light & Power Company, of Media, N. Y., the Public Service Commission of the Second District has authorized an issue of $34,000, 20-year five-per-cent first-mortgage bonds to be sold at not less than 90 to pay $30,000 on bills payable of the company which amounted to over $303,000 December 31, 1911. The company also is authorized to issue, under a new mortgage, first and refunding 30-year five-per-cent bonds, from which shall be reserved enough to retire, par for par, all prior-lien bonds outstanding at the time of this issue, after which the company may issue and sell for cash at not less than 90, $303,000 of the new bonds to net $272,000, with which sum all old bills payable of 1911 may be satisfied.

Salmon River Power Company, an operating subsidiary of the Niagara, Lockport & Ontario Power Company, has been authorized by the Public Service Commission of the Second District to issue $300,000 additional of its 40-year, five-per-cent, first-mortgage bonds to be sold at not less than 85 and to net the company $255,000. Proceeds of these bonds are to be used for the discharge of obligations arising out of the construction of the hydroelectric plant of the company and its transmission system, not provided for by the issues of bonds already authorized. Part of the proceeds will be used to complete construction. This makes a total issue of bonds for this project of $3,535,000. In the authorization of this latest amount the commission specified that it does not now determine that the present work done is more than 85 per cent of the value of the securities issued against it. In case the company finds it necessary to ask for further authorization of bonds the commission will require that it be shown that construction work completed is above 85 per cent of the bonds which have been authorized against it.

Capitalization plans of the Ohio Electric Securities Company, which, financed by Close Brothers, of London, England, is building the big central power station at Floodwood, O., in the heart of the Hocking Valley coal fields, are announced. They provide that the total capital stock shall consist of $2,500,000, divided into 25,000 shares of common and 15,000 shares of non-voting seven-per-cent cumulative preferred stock, all shares at the par value of $100 each. The company is to be organized as a corporation under the laws of the state of Maine, and is to be the holding company for all subsidiaries that may be created. All the stock of underlaying companies to be acquired is to be retained in the treasury of the Ohio Electric Securities Company. No bonds are to be issued in anticipation of the completion of the plant. The preferred stock is to be entitled to seven per cent annually, cumulative, after which the common stock will be paid such earnings as may be had. For every dollar of stock put in by the original investors two dollars of preferred stock and two dollars of common stock shall be issued to them therefore, and the certificate of F. C. Elliott, trustee, issued temporarily in lieu thereof pending the organization of the incorporation and the completion of the building operations undertaken by F. C. Elliott, trustee. The balance of the stock shall be disposed of by the board of directors as in their judgment may seem best pending the organization of the company. All property is to be conveyed to F. C. Elliott, trustee, and all money invested by the original investors paid to him as said trustee, for which money and property said trustee shall issue ad interim certificates evidencing their interest in the property and for stock to be issued to them in the amounts aforesaid at the surrender of said ad interim certificates. The Ohio Electric Company, as the holding company, shall furnish all the finances necessary to purchase, build and equip all plants for the manufacture, distribution and sale of electricity in the Hocking Valley district of Ohio; which plants shall be separate operating corporations under the laws of Ohio. This financial plan with respect to subsidiary companies is expected to popularize same by giving such companies in each instance the form of a local enterprise through the holding of stock by home capital. The one subsidiary so far organized, the Hocking Power Company, takes in a group of small towns, with the Nelsonville franchise as a base. This is particularly valuable, as it was granted a number of years ago as a perpetual franchise, when such a thing was legal. The right in perpetuity has been affirmed by the United States Court. The franchise was recently acquired by the Hocking Power Company through purchase. The F. C. Elliott, mentioned in connection with the Ohio Securities Company, is trustee for Close Brothers, with headquarters in Chicago.

Dividends.

	Term	Rate	Payable
Cent. Ark. Ry. & Lt. Corp. pf.	Q	1.75%	Sept. 1
Kings Co. El. Lt. & Pr.	Q	2 %	Sept. 1
White Eng. Corp pf.	Q	1.75%	Sept. 1
White Management, J. G., pf.	Q	1.75%	Sept. 1

Reports of Earnings.

GRAND RAPIDS RAILWAY.

	1914	1913
June gross	$ 109,413	$ 112,045
Net after taxes	38,762	47,189
Surplus after charges	25,401	31,881
Twelve months' gross	1,297,010	1,270,291
Net after taxes	459,217	531,164
Surplus after charges	301,337	353,723
Balance after preferred dividends	226,337	278,723

CENTRAL STATES ELECTRIC CORPORATION.
(Cleveland Electric Illuminating Co.)

	1914	1913
May gross	*$ 348,057	$ 307,075
Net after taxes	162,788	152,403
Surplus after increased preferred dividends am.	126,024	118,806
Balance after depreciation	91,219	88,099
Twelve months' gross	*4,246,805	3,539,344
Net after taxes	2,053,417	1,689,143
Surplus after increased preferred dividends am.	1,638,389	1,279,997
Balance after depreciation	1,214,734	858,060

*Earnings since April 25, 1914, are subject to adjustment after decision in pending rate proceedings, the exact result of which cannot now be determined.

MONTREAL TRAMWAYS.

The report of the Montreal Tramways Company for the year ended June 30, 1914, compares as follows:

	1914	1913
Gross	$7,142,804	$6,754,227
Operating expenses	4,206,115	4,032,663
Net	2,936,690	2,721,563
From which deduct:		
City's per cent of earnings	527,384	489,080
Interest and taxes	1,672,468	1,594,152
Net income	736,837	638,331
Dividends	242,056	156,382
Surplus	494,781	481,949
Discount on bonds transferred to contingent fund reserve account	357,237	287,384
Surplus	137,544	194,565

UNITED LIGHT & RAILWAYS.

Consolidated earnings of subsidiaries for twelve months ended June 30, 1914:

	1914	1913
Gross earnings	$6,199,421	$5,712,538
Net after operating expenses, maintenance and taxes	2,382,350	2,348,973
Holding company earnings:		
Earning from stocks, own	$1,366,543	$1,234,736
Miscellaneous earnings	124,811	86,514
Total gross earnings	1,491,354	1,321,251
Net after expenses and taxes	1,393,970	1,241,320
Surplus after interest charges	992,372	903,343
Balance after preferred dividends	464,439	450,672

NORTHERN OHIO TRACTION & LIGHT.

	1914	1913
June gross	$ 317,780	$ 291,517
Net after taxes	118,255	113,162
Surplus after charges	67,235	67,949
Balance after preferred dividends	52,144	54,557
Six months' gross	1,721,200	1,497,237
Net after taxes	662,065	568,779
Surplus after charges	360,230	298,055
Balance after preferred dividends	270,113	225,673

PACIFIC LIGHT & POWER.

	1914	1913
June gross	$ 220,932	$ 210,288
Gross income	148,509	100,238
Surplus after charges	45,540	61,772
Six months' gross	1,274,814	1,262,416
Gross income	827,965	614,886
Surplus after charges	222,196	379,348

Large increase in interest charges for June and for six months is due to fact that since January 1, 1914, interest on first and refunding bonds issued in connection with Big Creek hydroelectric development have been charged against income and previously to that date was charged against construction.

CONSUMERS POWER OF MICHIGAN.

	1914	1913
June gross	$ 255,055	$ 226,768
Net after taxes	144,534	91,032
Surplus after charges	77,344	30,881
Twelve Months' gross	3,297,579	2,998,584
Net after taxes	1,705,518	1,435,263
Surplus after charges	869,092	741,175
Balance after preferred dividends	534,092	452,675

CUMBERLAND COUNTY POWER & LIGHT.

	1914	1913
June gross	$ 217,868	$ 200,339
Net after taxes	98,222	92,295
Surplus after charges	34,623	34,316
Twelve months' gross	2,447,406	2,213,749
Net after taxes	1,037,451	988,198
Surplus after charges	284,146	312,899
Balance after preferred dividends	*146,146	202,899

*Equivalent to 5.4 per cent on common stock.

LEWISTON, AUGUSTA & WATERVILLE STREET RAILWAY.

	1914	1913
June gross	$ 62,002	$ 63,459
Net after taxes	21,745	25,439
Surplus after charges	6,166	10,580
Twelve months' gross	677,723	650,004
Net after taxes	219,549	248,772
Surplus after charges	34,715	74,638
Balance after preferred dividends	*1,285	38,638

*Deficit.

PERSONAL MENTION.

MR. J. O. MORRIS has been elected secretary and sales manager of the Electric Supply & Equipment Company, Hartford, Conn., to fill the vacancy caused by the resignation of Mr. T. J. O'Brien.

MR. J. M. ROBERTS, of San Antonio, Tex., has moved with his family to Kerrville, Tex., and will conduct the business of the Kerrville electric light and ice plant as president and general manager.

MR. T. S. DICK, a travelling auditor for the Westinghouse Lamp Company, with headquarters in New York City, is in Salt Lake City checking up the Inter-mountain district of this company. His work will require from one month to six weeks.

MR. R. J. ROTE has been appointed general manager of the Trio Manufacturing Company, Rock Island, Ill., replacing MR. CHARLES A. WALKER. Mr. Rote has been for many years engaged in the electrical manufacturing and sales lines.

MR. P. M. MONTGOMERY has purchased Mr. A. M. Grant's interest in the Standard Electric Company in Brookfield, Mo., and has assumed management. Mr. Montgomery has for ten years been well known in the electrical supply business in Topeka, Kans.

MR. WILLIAM G. NORMAN, for seven years manager of the North American Telegraph Company, at Dubuque, Iowa, has severed his connection with the company and is succeeded by MR. W. O. BRUCKMANN, who has been associated with the company's office at Winona, Minn., for several years.

MR. GEORGE C. ANDERSON, of the Stone & Webster organizations, Boston, Mass., was married on August 7 at Savannah, Ga., to Miss Violet Elizabeth Brookfield, daughter of Col. A. M. Brookfield, the British Consul at Savannah, Rev. S. B. McGlohon, rector of St. Paul's Episcopal Church, officiating. Miss Daisy and Miss Cornelia Brookfield, sisters of the bride, were bridesmaids. Following the ceremony a reception was held, after which the couple left for New York City. Mr. and Mrs. Anderson will reside in Boston.

MR. FRANK E. BROWN has become associated with the H. W. Johns-Manville Company, and will act as special representative, devoting his attention to the further sales development of "Noark" service meter protective devices. Mr. Brown is well known to engineers in the United States and Canada, as he was for twenty years (1889-1909) electrical engineer for the department of water supply, gas and electricity, New York City. While in charge of electrical affairs for New York City, Mr. Brown was prominent in creating the demand for and in urging the adoption of meter protective devices among the lighting companies of the country.

MR. C. A. HANSEN, specialist for the General Electric Company on the electric furnace and the electrical separation of zinc and copper, is in Salt Lake City going over the works of the Utah Copper Company at Bingham for the purpose of determining the feasibility of applying electrical ore separation to the work of his company. Managing Director D. C. Jackling, of the Utah Copper Company, who is also president of the Utah Power & Light Company, which has a contract with the former for supplying the electrical requirements of all of its smelting and mining work, is very much interested in the problem and is lending every assistance toward its solution.

MR. A. J. EDGELL, of The Society for Electrical Development, has been elected second vice-president of the International Association of Display Managers. Mr. Edgell delivered an address at the seventeenth annual convention of this organization in Chicago on August 5, which made a very favorable impression. In the course of his talk he showed a large number of electrical devices for window display and store-front illumination, and illustrated their use under varying conditions. President Potter, in introducing Mr. Edgell, called especial attention to the work of the society in this line, stating that it had given the art of window trimming "the biggest boost that it had ever received." Mr. Edgell is president of the Greater New York Display Managers' and Window Trimmers' Association, and was last year awarded both of the prizes offered by the national organization for the most original and attractively arranged display.

MR. HARRY G. D. NUTTING announces the opening of an office as public utility expert and engineer, in the First National Bank Building, Milwaukee, Wis. Mr. Nutting's services will be available for valuations, rates, audits, commercial development, expert testimony, management, traffic surveys, engineering, accounting, examinations, reports, etc., for gas, electric light and power, electric railway, central heating, and water works properties. After his graduation from the college of engineering of the University of Illinois, he did extensive practical experimental work for Fairbanks-Morse Company. He was afterwards engineer for the Wisconsin Railroad Commission, manager of a municipal plant, district superintendent in charge of operation of eighteen towns in Illinois, and electrical engineer for the Government Arsenal at Rock Island. Mr. Nutting has retired from the position of assistant to the president of the Wisconsin Public Service Company, Wisconsin Railway, Light & Power Company, and Evanston (Ill.) Railway Company to establish his own business. He has been retained by these companies as consulting expert. The work he has done in connection with them, as well as the positions he has previously filled, has given him not onlv a broad experience in every branch of the public utility business, but a valuable acquaintance with the methods and procedure of public service commissions. He is also consulting expert for the Berlin (Wis.) Public Service Company in connection with its rate case now pending before the Wisconsin Commission. His practical experience in engineering, accounting, and management fits him to be of service to utilities needing assistance. He has been a contributor to technical literature and read a paper on "Accounting System for a Small Public Utility" at the January, 1914, convention of the Wisconsin Electrical Association. He is also chairman of the Committee on Extensions and Commercial Service Rules of the Association and the author of a unique formula for determining the advisability of making extensions of distribution systems.

OBITUARY.

MR. J. R. McLAIN, who for a number of years has been connected with the electrical department of the H. W. Johns-Manville Company, New York, contracted a severe attack of pneumonia several months ago, and was under special care and treatment in the Hahnemann Hospital, New York City. Notwithstanding Mr. McLain's prolonged illness and great suffering, strong hopes were felt that he would recover, when on Tuesday, July 28, a sudden change in his condition was noted and he quietly passed away. Mr. McLain had many friends in the electrical field who will feel that his untimely end is a personal loss to them. He was a man of unusual ability and was held in the highest esteem by all who chanced to know him, and particularly those with whom he came in daily contact. The remains were removed to his old home in Cincinnati, O., for interment.

NEW INCORPORATIONS.

VINALHAVEN, ME.—The Vinalhaven Electric Power Company has been incorporated with a capital stock of $50,000 by Thomas E. Libby, Frederick S. Walls, Vinalhaven; Henry J. Sage, and Charles H. Bradley, Jr., of Boston, Mass. W.

AUGUSTA, ME.—The Railway Signal & Equipment Company has been incorporated with a capital stock of $1,000,000, by Ernest L. McLean, Frank E. Southard, E. A. Cushman, R. S. Buzzell, L. J. Coleman, Augusta; E. M. Leavitt, Winthrop and Pauline Lowell, of Hallowell, Me. W.

HARRISBURG, PA.—An application for a Pennsylvania charter of incorporation for the Insulation Products Company, will be made by B. H. Thompson, G. M. Newmyer and E. D. Bell. The new concern will manufacture mechanical and electrical machinery. N.

PORTLAND, ME.—The Coe-Halsted Company has been incorporated with a capital stock of $1,000,000, for the purpose of carrying on the business of machinists, mechanical, electrical and civil engineers. The incorporators are Albert F. Jones, T. L. Crotean, B. M. Maxwell, Portland. W.

PORTLAND, ME. — The United States Train Signal Company has been incorporated with a capital of $1,000,000, by William E. Benn, McAdam Jct., N. B.; George E. Davis, J. Renfrew Kirkpatrick, Debec Jct., N. B.; Albert J. Violette, St. Leonard, N. B.; Willis B. Hall, Portland. W.

HARRISBURG, PA.—An application for a Pennsylvania charter of incorporation for the Electrical Engineering & Manufacturing Company, will be made by Robert S. Chess, William F. Knoell and A. W. Forsyth. The new concern will manufacture electrical machinery. N.

CLEVELAND, O.—The American Electric Clock Company has been incorporated with a capitalization of $100,000, for the purpose of manufacturing electrically-operated clocks and clock systems for business and industrial uses. Those interested are L. R. Houston, J. A. Dunn, F. W. Huston, J. G. and R. H. Bricker. L.

DATES AHEAD.

Southeastern Section, National Electric Light Association. Annual convention, Isle of Palms, Charleston, S. C., August 19-21. Secretary, A. A. Wilbur, Columbus, Ga.

American Peat Society. Annual meeting, Duluth, Minn., August 20-22. Secretary, Julius Bordello, 17 Battery Place, New York, N. Y.

New England Section, National Electric Light Association. Sixth annual convention, Narragansett Pier, R. I., September 2-4. Secretary Miss O. A. Bursiel, 149 Tremont Street, Boston, Mass.

The Colorado Electric Light, Power and Railway Association. Twelfth annual convention, Glenwood Springs, Colo., September 3-5. Secretary, Thomas F. Kennedy, 900 Fifteenth Street, Denver, Colo.

Pennsylvania Electric Association. Annual convention, Eagles Mere, Pa., September 8-11. Secretary, S. E. Pohe, Bloomsburg, Pa.

Northwest Electric Light & Power Association. Annual convention, Spokane, Wash., September 8-11. Secretary, Norwood W. Brockett, Puget Sound Traction, Light & Power Company, Seattle, Wash.

American Institute of Electrical Engineers. Pacific Coast convention, Spokane, Wash., September 9-11. Secretary, F. L. Hutchinson, 29 West Thirty-ninth Street, New York, N. Y.

Electrical Supply Jobbers' Association. Regular quarterly meeting, Clifton Hotel, Niagara Falls, Canada, September 9-11. General secretary, Franklin Overbagh, 411 South Clinton Street, Chicago.

Association of Edison Illuminating Companies. Annual convention, White Sulphur Springs, W. Va., September 14-17. Secretary, George C. Holberton, San Francisco, Cal.

Association of Iron and Steel Electrical Engineers. Annual convention, Cleveland, O., September 14-19. Secretary, W. T. Snyder, McKeesport, Pa.

Old-Time Telegraphers' and Historical Association and Society of the United States Military Telegraph Corps. Thirty-third annual reunion, Kansas City, Mo., September 15-17. Secretary of Old-Timers, F. J. Scherrer, 30 Church Street, New York. Secretary, Military Telegraph Corps, David Homer Bates, 658 Broadway, New York.

International Association of Municipal Electricians. Annual convention, Atlantic City, N. J., September 15-18. Secretary, C. R. George, Houston, Tex.

Illuminating Engineering Society. Annual convention, Cleveland, O., September 21-25. Assistant secretary, Joseph Langan, 29 West Thirty-ninth Street, New York, N. Y.

American Electrochemical Society. Twenty-sixth general meeting, Niagara Falls, N. Y., October 1-3. Secretary, Joseph W. Richards, South Bethlehem, Pa.

American Electric Railway Association. Annual convention, Atlantic City, N. J., October 12-16. Secretary, E. B. Burritt, 29 East Thirty-ninth Street, New York, N. Y.

Jovian Order, annual congress, St. Louis, Mo., October 14-16. Mercury, Ell C. Bennett, Syndicate Trust Building, St. Louis, Mo.

Electric Vehicle Association of America. Fifth annual convention, Philadelphia, Pa., October 19-21. Secretary, A. J. Marshall, 29 West Thirty-ninth Street, New York, N. Y.

Telephone Pioneers of America. Annual reunion, Richmond, Va., October 29-30. Secretary, Henry W. Pope, New York City.

With the Electrical Manufacturers

Northern Engineering Works, Detroit, Mich., announces that it has received an order for two 10-ton four-motor overhead traveling cranes for the new stock house of the Crane Company, of Chicago.

The Hess-Bright Manufacturing Company, Philadelphia, Pa., has issued a bulletin on ball bearings in machine tools. This bulletin discusses the advantages of using ball bearings for the rotating parts of machine tools and is illustrated by numerous cuts of actual installations. Several cuts show the application of ball bearings to electric motors.

Terry Steam Turbine Company, Hartford, Conn., has recently received an order for 20 turbines for driving auxiliaries in the new generating station of the Philadelphia Electric Company. The Terry company has just improved its manufacturing facilities by installing new machine tools, increasing the capacity of its plant 25 per cent.

Dielectric Manufacturing Company, St. Louis, Mo., has recently issued a pamphlet entitled "Data On Dependable Insulation." This pamphlet gives data and curves on various types of insulating products such as mica, mineral oils, varnishes, paints, varnished muslin tape, etc. Prices of the company's various insulating and soldering products are given.

Société D'Appareils De Mesurses, 49, Rue De La Procession, Paris, France, has recently issued a bulletin devoted to a description of an electrometer for use in measures of radioactivity. This electrometer is portable and is well adapted for use by the physician or the experimenter and scientist. The principle upon which the electrometer operates and the construction of the meter are fully explained and numerous cuts are used to illustrate the bulletin.

Western Electric Company, New York City, has recently issued a very handsome bulletin on modern methods in train dispatching. After a summary of the progress made in train dispatching from the day of the first locomotive until the present time, a comparison is drawn between the telegraph and telephone systems of dispatching. The names of numerous railroads using the telephone system of dispatching are given and excellent illustrations of the company's apparatus for railroad dispatching are included.

Kellogg Switchboard & Supply Company, Chicago, Ill., has taken a 20-year lease on the new factory building being erected for its occupancy at Adams and Aberdeen Streets. The structure is of the most modern type and will cost $600,000. It will give the company 350,000 square feet of floor area, that is, greatly increased and improved facilities, for manufacturing telephones and telephonic apparatus and supplies. The annual business of the company is now approximately $3,250,000, whereas ten years ago it was about $350,000.

Allis-Chalmers Manufacturing Company, Milwaukee, Wis., has added to its publications Bulletin No. 1085, which deals with kerosene engine-driven generating sets. These consist of an Allis-Chalmers direct-current generator and field rheostat mounted on the same base and coupled to a Falk standard throttling-governor kerosene engine; included in the outfit there are also fuel and cooling tanks, muffler and necessary pipe and electrical connections, tools, etc. These sets are rated from 1 to 18 kilowatts and are designed for either 125 or 250 volts. The company has also recently issued Bulletin No. 1087 devoted to polyphase induction motors. These machines are made both in the squirrel-cage and the wound-rotor types. The bulletin describes these in great detail with the aid of many illustrations of parts and of the complete motors. Control and auxiliary apparatus is also described. There are given many views of typical power installations using these motors for a variety of purposes.

White Lily Manufacturing Company, Davenport, Iowa, has issued a catalog of its various types of washing machines. These are made so as to operate with several kinds of power, electric, gasoline, water and hand power. Each of the numerous types of washers is illustrated and described in detail. Among the new types of electric washers is the De Luxe and the White Way platform electric washer.

The Dayton Engineering Laboratories Company, Dayton O., has published for distribution among automobile dealers "The Book of the Delco." This is a large and very attractive book containing about 100 views in the various departments of its factory. These views are reproduced with the

highest skill of the engravers' art and give an excellent idea of the magnitude, efficiency and thoroughness of this organization's manufacturing and testing facilities. Among the many views published are several in the various laboratories of the company, a large number in the numerous machine-tool rooms, in which special automatic machinery is very extensively employed, the assembly, inspection and testing departments, views of safety devices to guard against injury to workmen, etc.

Trumbull-Vanderpoel Electric Manufacturing Company, Bantam, Conn., is arranging to distribute a new edition of the T-V catalog. This catalog lists a complete line of panel boards, switchboard cabinets and knife switches. A helpful feature of the new catalog is the marginal thumb index, facilitating the securing of information relating to any device. The Stuart-Howland Company, Boston, Mass., has recently published a strong letter to the trade signed by G. M. Stuart, president, endorsing the Trumbull-Vanderpoel material and offering to send complete information.

The H. W. Johns-Manville Company, New York, N. Y., announces the appointment of G. Eugene Villaret in charge of the designing of lighting fixtures. Mr. Villaret is widely known through the many important and beautiful installations for which he has been responsible during the last quarter of a century. After finishing his studies at the Beaux Arts, Paris, Mr. Villaret was for 14 years with the Thackara Manufacturing Company, Philadelphia, makers of lighting fixtures, and during the past 10 years he has been connected with Cassidy & Sons Manufacturing Company, New York. Edward L. Cox has been appointed manager of the lighting division of the electrical department of the company. The lighting division has been organized to handle the company's business in lighting fixtures which has grown with great rapidity. Mr. Cox is familiar with the lighting-fixture business from every angle, having been for 18 years with the Enos & Watkins Company, (formerly the Enos Company). Because of his experience in designing, manufacturing and selling, Mr. Cox is especially well qualified to direct the work of the new division.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., reports the receipt of the following orders for mine apparatus: Anaconda Copper Mining Company, Butte, Mont., eight 150-horsepower, 14-pole motors, with impregnated winding, to be operated in couples for driving quintuplex mine pumps, each complete with automatic starter and separately mounted autotransformers. Same company, Great Falls, Mont., two eight-ton bar-steel electric locomotives of particularly heavy construction for "bunting" charging cars about the smelter. Same company for Lochray Coal Department, one 75-kilowatt motor-generator set and switchboard. Daly West Mining Company, Park City, Utah, one 175-horsepower 16-pole motor with magnet-switch hoist control; one 400-horsepower synchronous motor, with exciter and switchboard, for driving a Laidlaw-Dunn-Gordon air compressor. Utah Copper Company, Magna, Utah, four 10-horsepower special vertical motors for driving agitators for oil flotation (third repeat order for this customer covering motors for this specially developed application). Same company, Bingham, Utah, six one-kilowatt turbogenerator units for supplying light to steam shovels operating in the copper mine. Yukon Gold Company, Idatrod, Alaska, six 125-kilovolt-ampere transformers. Jualin Alaska Mines Company, Jualin, Alaska, one 100-kilowatt waterwheel generator; three 25-kilovolt-ampere transformers; one 75-horsepower motor; one two-panel switchboard. Kennecott Mines Company, Kennecott, Alaska, one 75-horsepower special motor with magnet brake and automatic control to drive a tramway and under certain conditions to operate as an asynchronous generator; one 500-kilowatt, three-phase turbogenerator and two-panel switchboard. Alaska Treadwell Gold Mining Company, Treadwell, Alaska, one 4.5-ton, storage-battery locomotive with two motors and 68 cells of Edison battery; also one eight-ton barsteel trolley locomotive with 500-volt equipment; one 200-horsepower 2,200-volt motor with magnet switch control for automatic acceleration (this is the largest electric hoist motor in Alaska and the first magnetic switch control ever installed there). Beatson Copper Company, Latouche, Alaska, two 625-kilowatt, 2,300-volt, three-phase turbogenerators; one six-panel switchboard; two 16-kilowatt motor-generator exciter sets. Tonopah Merger Mining Company, Tonopah, Nev., one 250-horsepower synchronous motor with switchboard panel and motor-generator set for driving Sullivan air compressor. Tonopah Belmont Development Company, Tonopah, Nev., one 125-horsepower motor for direct connection to Nordberg mine hoist; and 75-horsepower motor for direct-connection to Aldrich pump. Burro Mountain Copper Company, Burro, N. M., four 300, six 100, and three 37.5-kilovolt-ampere transformers. United Verde Copper Company, Clarkdale, Ariz., three 300, and three 30-kilovolt-ampere transformers for a new smelter.

Record of Electrical Patents.

Issued by the United States Patent Office, August 4, 1914.

1,105,629. Four-Party Key. A. F. Dixon, assignor to Western Electric Co. A four-party operating key.

1,105,653. Sign. J. A. Hanggi, St. Paul, Min. An electric sign.

1,105,656. Electric-Furnace Process and Electric Furnace. C. Hering, Philadelphia, Pa. Molted metal used as conductor.

1,105,659. Sparking Device for Internal-Combustion Engines. G. Honold, assignor to The Firm of Robert Bosch, Stuttgart, Germany. Coil forms part of plug.

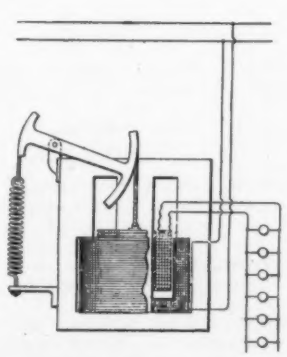
1,105,662. Insulated Trolley Crossing. C. Hornstein, Indianapolis, Ind. An insulated crossing for trolley wires.

1,105,664. Insulated Cleat. B. G. Jansson, assignor to Blake Signal & Mfg. Co., Boston, Mass. An insulating rail.

1,105,696. Speed Governor for Prime Movers. G. Rennerfelt, New York, N. Y., assignor of one-half to A. Sundh. A motor-driven speed control for turbogenerators.

1,105,716. System of Distribution. E. Thompson, assignor to General Electric Co. A regulator for maintaining constant voltage in a secondary circuit. (See cut.)

1,105,746. Sparking Plug for Internal-Combustion Engines. E. Blattman, assignor to Siemens & Halske, A. G., Berlin, Germany. Covers details.



1,105,716—Constant-Potential Transformer.

1,105,754. Electric Train Distribution. E. R. Carichoff, assignor to General Electric Co. A motor-generator system for pumping back energy.

1,105,761. Relay Sounder Attachment. S. L. Dickson, Short Creek, W. Va. Has diaphragms for producing audible sounds.

1,105,766. Individual Calling-Key. M. F. Geer and R. C. Leake, Rochester, N. Y., assignors to General Railway Signal Co., Gates, N. Y. Operation of key controls generator.

1,105,770. Miniature Electric Lamp. H. E. Gustafson, Pueblo, Colo. A bracket for a miniature lamp.

1,105,783. Cooling Electrical Apparatus. H. M. Hobart, assignor to General Electric Co. For a transformer.

1,105,786. Machine for Making Fiber Insulating Sheets. T. Hohaus, assignor to Union Fibre Co., Winona, Minn., Includes means for passing fibrous stock under water and afterwards interlacing fibers.

1,105,787. Apparatus for Ignition of Reversible Internal-Combustion Motors. G. Honold, assignor to The Firm of Robert Bosch. A magneto.

1,105,793. Automatic Signaling Device. P. C. Johnson, Halifax, Nova Scotia, Canada. A steering-wheel controlled automobile signal.

1,105,806. Computing-Scale Illuminating Device. C. B. Longstreeth, assignor to Jonathan B. Hayward, New York, N. Y. Has incandescent lamp.

1,105,811. Sequence-Switch. F. R. McBerty assignor to Western Electric Co. A rotating switching device.

1,105,829. Electric Signaling Mechanism. O. D. Plummer, G. H. Hausser and E. A. Warner, Altoona, Pa. Motor, magnet and lamp mechanism for railroad signals.

1,105,837. Signal-Receiving Device. C. S. Rhoads, Jr., assignor to Hall Switch & Signal Co. A step-up signal receiving device.

1,105,842. Substation Signaling Apparatus. H. O. Rugh, assignor to Hall Switch & Signal Co. A modification of 1,105,837.

1,105,843. Control System. H. O. Rugh, assignor to Hall Switch & Signal Co. For a number of stations.

1,105,855. Support for Electric-Lamp Sockets. J. A. Smith, assignor to Reliable Electric Co., Chicago, Ill. Wire support for attaching to table.

1,105,859. Electric Furnace. E. Stassano, Turin, Italy. Has special oscillating means.

1,105,860. Signaling System. C. Stephens, assignor to A. H. Calligan, Richmond, Va. A block-signal system.

1,105,883. Fault Localizer. E. E. F. Creighton, assignor to General Electric Co. For locating grounds in cable. (See cut.)

1,105,887, Arc-Lamp Electrode. C. W. Dake, assignor to Pyle-National Electric Headlight Co., Chicago, Ill. Positive electrode has metallic sheath.

1,105,907. Contact Switch Box. S. R. Hipple, Williamsport, Pa., and W. L. Conwell, Montclair, N. J. An electromagnetic switch.

1,105,908. Incandescent Electric Lamp. W. G. Hughes, Pittsburgh, Pa. Has spirally wound filament.

1,105,920 and 1,105,922. Telegraphy. L. M. Potts, assignor to Austin McLanahan, Baltimore, Md. Automatic transmission device.

1,105,923. Railway Signaling or Train Control. F. W. Prentice, Toronto, Ontario, Canada, assignor to The Perry-Prentice Electric Co. Utilizes Hertian waves.

1,105,924. Telephone. E. S. Pridham and P. L. Jensen, assignors to Commercial Wireless & Development Co., San Francisco, Cal. A receiver of the moving-coil type.

1,105,938. Lock for Portable Articles. A. C. Terrill, Glendale, Cal. A key locking device for incandescent-lamp socket.

1,105,962. Electrically Heated Device. F. E. Carlson, assignor to Landers, Frary & Clark, New Britain, Conn. Has heating coils.

1,105,984. Apparatus for the Production of Continuous Electrical Oscillations. H. Manders, London, England. Covers details of shape of oscillation electrodes.

1,105,988. Generator - Suspension Member. C. E. Mead, assignor to Central Trust Co. of New York. For hanging car-lighting generator.

1,106,001. Telegraph Repeater. G. L. Rawdon, Cleveland, O. Has two relays, one of which is triple wound.

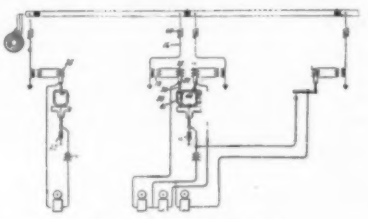
1,106,053. Connector. L. C. Nichols, Milwaukee, Wis., assignor to Allis-Chalmers Mfg. Co. A sleeve connector.

1,106,092. Train Controlling and Stopping System. G. R. Guild, Fort Bayard, N. Mex., assignor of one-half to W. J. Brown. Is track operated.

1,106,095. Electrical Battery. A. S. Hubbard, assignor to Gould Storage Battery Co. Covers mechanical details.

1,106,103. Means for Supporting Electric Devices. G. A. Lutz, Plainfield, N. J. A molding fitting.

1,106,116. Remote Control System.



1,105,883—Fault Localizer.

W. M. Scott, assignor to The Cutter Electrical & Manufacturing Co. A motor-operated switch.

1,106,118. Switchboard Plug. L. H. Snyder, White Lake, S. D. An insulated plug connector. (See cut.)

1,106,125. Battery. W. E. Winship, assignor to Gould Storage Battery Co. Covers details.

1,106,126. Operating Device for Electric Switches. A. T. Ytterberg, assignor to W. M. Scott, Berwyn, Pa. Includes electromagnetic switches.

1,106,127. Egg-Testing Devise. M. P. Baken, Hayfield, Minn. Has incandescent lamp.

1,106,134. Signal for Motor Vehicles. O. W. Cowgill, St. Louis, Mo., assignor of nine-tenths to O. F. Stifel. An incandescent-lamp semaphore.

1,106,148. Rotating Sign. J. S. Kendall, Hamilton, Ontario, Canada. A rotating electrically illuminated sign.

1,106,151. Fire-Alarm System. G. H.

1,106,118—Switchboard Plug.

Matthews, Uniontown, Pa. Utilizes fuses.

1,106,154. Switch-Locking Device. J. A. Nash, Butler, Pa. Locking device for knife switch.

1,106,164. Inspection-Car. J. Stofa, Elgin, Ill. Carries electrical testing apparatus.

1,106,166. Electric Furnace. N. Testrup and T. Rigby, Dumfries, assignors to Wetcarbonizing Limited, London, England. A smelting furnace.

1,106,183. Cable Hook. A. F. Berger, Holden, W. Va. Means for hooking cables.

1,106,187. Electromagnet and Similar Apparatus. P. Bossu, assignor to Societe Anonyme des Establissements L. Bleriot, Paris, France. Resistance compensates for variations in reluctance.

1,106,230. Contact Interrupter. A. H. Maitre and V. H. Martin, Rouen, France. Electromagnet operates vibrator.

1,106,281. Time Switch. M. Chiavetta, New York, N. Y. Controlled by clock-gear train.

1,106,284. Accounting System. W. J. Crumpton, assignor, by mesne assignments, to W. R. Heath, Buffalo, N. Y. Electrically operated.

1,106,294. Elevator-Door Safety Device. E. M. Frasier, San Francisco, Cal., assignor of one-third to George B. Seaman and one-third to A. D. Seaman. A door switch.

1,106,334. Car Heater. W. S. Menden, Brooklyn, N. Y., assignor to Megosin Co., Inc. An electric heater.

1,106,347. Electrode for Welding. A. B. Herrick, assignor to The Electric Railway Improvement Co., Cleveland, O. A laminated electrode.

Patents Expired.

The following United States electrical patents expired August 10, 1914:

587,693. Signal-Receiving Apparatus. W. F. Banks, Milford, Conn.

587,698. Apparatus for Detecting Electrolysis of Underground Pipes and Locating Transmission Losses. H. P. Brown, New York, N. Y.

587,720. Electric Railway System. S. D. Field, Stockbridge, Mass.

587,733. Electric Controller. S. Harris, Johnstown, Pa.

587,750. Electric Arc Lamp. J. McLaughlin, Chicago, Ill.

587,752. Electric Railway Switch. M. J. M. O'Hara, Wilmington, Mass.

587,764. Wire for Armature Winding. S. H. Short, Cleveland, O.

587,765. Armature for Dynamo-Electric Machines. S. H. Short.

587,769. Electric Motor. J. L. Thoma, Kansas City, Mo.

587,792. Electric Railway. R. L. Caldwell, Cleveland, O.

587,798. Electric Meter. J. F. DeRauw, Brussels, Belgium.

587,818. Lightning Arrester. E. M. Hewlett, Schenectady, N. Y.

587,822. Automatic Electrical Regulating Device. E. W. G. C. Hoffman, Charlottenburg, and J. H. F. Gorges, Berlin, Germany.

587,838. Circuit-Breaker. H. Lemp, Lynn, Mass.

587,869. Field Magnet for Dynamo-Electric Machines. S. H. Short, Cleveland, O.

587,871. Armature. S. H. Short.

587,921. Apparatus for Generating Constant Electric Currents. C. N. Black, New Haven, Conn.

587,937. Regulating Electric Motors. A. G. Davis, Washington, D. C.

587,998. Electropneumatic Alarm. G. W. MacKenzie, Beaver, Pa.

588,004. Electric Alarm. R. Penney, National Military Home, O.

588,021. Machine for Controlling Electric Motors. S. H. Short, Cleveland, O.

588,046. Printing Telegraph. E. M. D. André, Merú, France.

588,048. Insulator for Wires. G. Ashby, Hamilton, Canada.

588,053. Overhead-Trolley System for Electric Railways. S. H. Cauffiel, Johnstown, Pa.

588,097. Electric Railway System. L. E. Watkins, Springfield, Mass.

588,101. Electrically Operated Loom. E. D. Chaplin, Cambridge, and H. G. Halloran, Boston, Mass.

588,104 and 588,105. Electric Locomotive. R. Eickemeyer, Yonkers, N. Y.

588,111. Current-Collecting Device for Electric Railways. R. M. Hunter, Philadelphia, Pa.